NOVEMBER, 1956

PIPE LINE INDUSTRY

Gulf Publishing Company

CONSTRUCTION • OPERATIONS • MAINTENANCE

B 622873 DEC 6 1956

SPECIAL AUTOMATION REPORT

Satellite Stations Are Paying Off ... p. 34

Computers Speed Pipe Line Design ... p. 43

How to Set Up a Training Program ... p. 47

How to Pick Electronic Instruments ... p. 51

COMMUNICATIONS

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MAINTENANCE

Better Maintenance Welding of Pipe ... p. 62

For a Quick Look at this issue, turn the page . . .

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PIPE LINE INDUSTRY

November, 1956 Vol. 5, No. 5

Ralph C. Hughes, Jr.

Ralph C. Hughes Joins Pipe Line Industry Staff

Ralph C. Hughes, Jr., has joined the staff of PIPE LINE INDUSTRY as associate editor. Hughes has been in the Engineering department of Sun Pipe Line Company since 1948. He has worked in various areas, and his experience has ranged from field engineering studies, purchasing of right-of-way, to supervision of construction. During the past 4½ years he has been resident engineer for Sun in four different areas. He is a 1948 engineering graduate of Texas A. & M. College.

•

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PIPE LINE INDUSTRY published every month. Entered as second class mail matter July 9, 1954, at the post office at Houston, Texas, under the act of March 3, 1879.

CONTENTS and Quick Look

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

SPECIAL AUTOMATION REPORT

Why Gulf Interstate Is Going to 'Satellites'

☐ Here are the economic reasons behind this company's decision to build four new satellite stations. Unattended operation of Gulf Interstate's Stanton, Ky., station has confirmed safety and dependability of design.

R. LoChiano ..... Page 34

Cut Calculating Time With Computers

☐ New electronic computation equipment makes the solutions to many pipe line engineering, operating, and accounting problems, quicker, more accurate and more economical. Here's how to free skilled employes for more productive thinking.

Gilbert V. Rohleder ..... Page 39

Computer Aids in Gas Pipe Line Design

☐ Here's how an electronic computer is helping El Paso Natural Gas Company design better pipe lines for less money. It's a complete report of how El Paso's computer operates, plus a step-by-step analysis of three major problems it has solved.

Harold E. Thomas ..... Page 43

Are Pipeliners Ready for Automation?

☐ Pipeliners aren't completely ready for automation, says an expert in the training field. Reasons: Shortage of engineers and skilled workers and an even greater shortage of training personnel.

By Richard W. Donnelly ..... Page 47

Select the Correct Electronic Instrument

☐ Use of electrical methods of measurement, data transmission, and control on long distance pipe lines is on the increase. Here is how to select instruments especially adaptable to the job.

By A. J. Hornfeck ..... Page 51

Engineer's Duties Are Threefold

☐ Here are some ideas to help "sell" automatic control. Where engineering studies prove that automation is economical on a pipe line system, the engineer must keep management informed and assist operations in maintenance, as well as design the system.

Fred S. Jones ..... Page 56

Why VHF System Used on Sui-Karachi Line

☐ Communications along Pakistan's 350-mile gas line into Karachi are handled by VHF radio-telephone system. How it is operated and why it was selected are discussed on ..... Page 58

Better Repair Welds on High Test Pipe

☐ Here are some new ideas that will eliminate underbead cracking on maintenance and repair welds. Results of a series of tests at Service Pipe Line Company shops are a good guide.

By A. M. Hill and F. W. Ziln ..... Page 62

Any Monopoly Is Bad

A menacing man-made giant has cast its suffocating blanket of power over American politics and industry. If it is allowed to reach maturity without restriction—one crush of its huge fist could mold the world's greatest economy like putty.

Its name is *labor union monopoly*. Its creators are a comparative handful of men who united 16 million Americans into a single group through the merger of the AFL and CIO.

Even before these two big labor organizations joined together as one—under one roof—there was anxiety about labor union "giantism." A poll conducted by the Opinion Research Corporation showed the public considerably more concerned about bigness in labor than bigness in business.

Despite the feelings of the public, several recent court cases prove that a double standard exists in federal antitrust laws: One under which business monopoly is prohibited—and one under which union monopolistic practices are freed of restraint.

Here are two freedom-jarring examples of what can happen when this nation's courts allow one segment of the public to flaunt the power of monopoly.

•

Labor unions' monopolistic power in politics. Shortly after the big labor union "wedding" last November, President Meany made the following declaration of labor's desire for power: "The scene of battle is no longer the company plant or the picket line. It has moved into the legislative halls of Congress and the state legislatures."

This month marks exactly one year since Meany's political battle cry became public record. And the time is long past due to evaluate the actions his words foretold.

The Committee on Political Education, political arm of the AFL-CIO, is staging an intensive campaign for contributions of $1 each from the organization's members—and for the enlistment of at least 2 million campaign workers.

AFL-CIO is also prepared to divert to political activity the services of more than 60,000 full-time paid union officers—to turn more than 1000 union newspapers, with circulations in the millions, into blatant promotional media for favored candidates—to infiltrate the strong party machines—to organize workers in all of the nation's voting precincts.

Principal objectives of organized labor's electioneering are the elimination of Taft-Hartley restrictions on union leadership activities; repeal of the existing right-to-work laws and the defeat of attempts to extend this protection against compulsory unionism to other states.

Through sheer power of numbers, AFL-CIO has already scored several impressive political victories. Included are the repeal of the right-to-work law in Louisiana last June—and the capture of the state Democratic organization in Michigan.

•

Labor unions' monopolistic power in industry. Because of court protection, labor unions are free to engage in boycotts—to divide territory and exclude business competition—to force employers to deal only with unionized contractors—to dictate what materials and equipment business firms may use—to force work stoppages and plant shutdowns—to drive companies out of business.

Webster defines monopoly as "*exclusive control of anything.*" This includes "exclusive control" brought about by labor union power as well as business power.

Is it fair to cut away at one "giant" with a myriad of restrictions, regulations and laws, while at the same time another is allowed the freedom of the law to develop its potential all-enveloping power?

The answer lies with those who make the laws of our country. They alone can put new teeth into the Sherman Act. It should and must deal with all monopoly power, whether it be manifested in combinations of employers or combinations of unions.

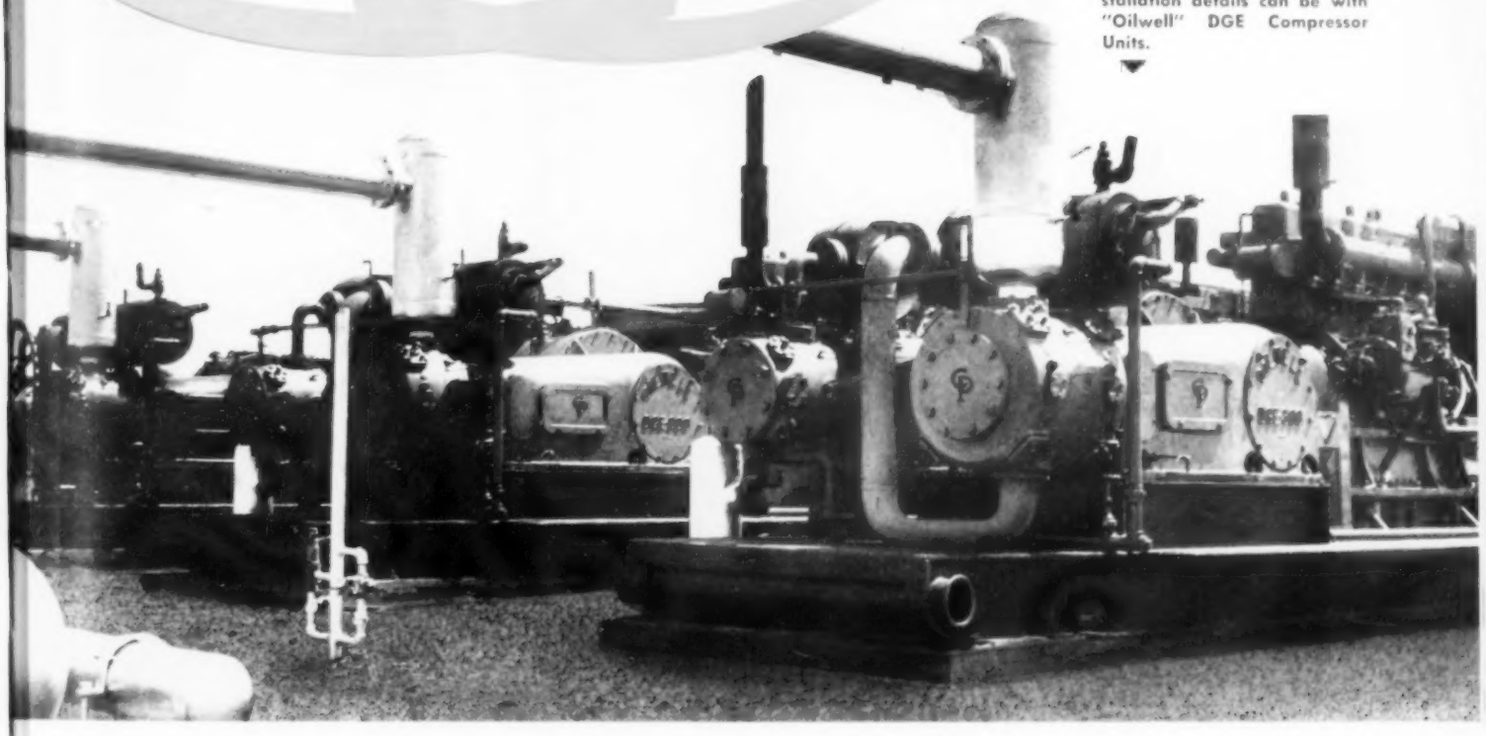
The warning flag is up. If the new giant ever decides to clench its huge fist, not only will relations between employers and employes be inside—but the nation's free economy as well.

Another Gas-Gathering System relies upon

"Oilwell" Direct-Connected Compressor Units

In this application, cooling fans are positioned outside the building. Updraft action eliminated consideration of prevailing wind problems.

This photo was made before the building was erected . . . showing how simple the installation details can be with "Oilwell" DGE Compressor Units.



Near Graham, Texas, Universoil, Inc. is gathering gas at field pressures of approximately 20 psi and discharging it into transmission lines at 800 psi with "Oilwell" DGE-300 two-stage compressor units. In this installation, each of the three units has a capacity of approximately 1,275,000 cu. ft. per day at compressor speeds of 300 rpm.

These duplex units consist of two slow-speed, horizontal-type compressors with top suction and bottom discharge connections. They are mounted side by side and are driven through right-angle, spiral-bevel gears by a single prime mover—all on a common skid base.

Each unit has its own heavy-duty, horizontal, updraft radiator with divided core for separately cooling the engine and compressor. For 250 and 300 hp sizes, the radiator and fan assembly is mounted adjacent to the engine and driven from the crankshaft by means of a torque tube and fluid coupling.

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PIPE LINE INDUSTRY and the **PIPE LINE COMPOSITE CATALOG** (first edition to be issued in July, 1957) for the oil and gas pipe line industry.

WORLD OIL and **THE COMPOSITE CATALOG** for the drilling-producing-pipe line industry.

PETROLEUM REFINER and **THE REFINERY CATALOG** for the refining-natural gas-line-petrochemical industry.

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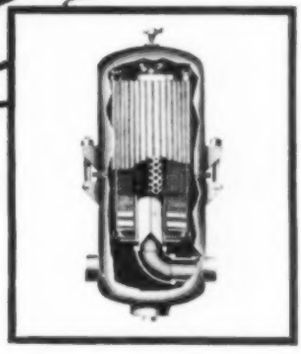
by Phil Tration



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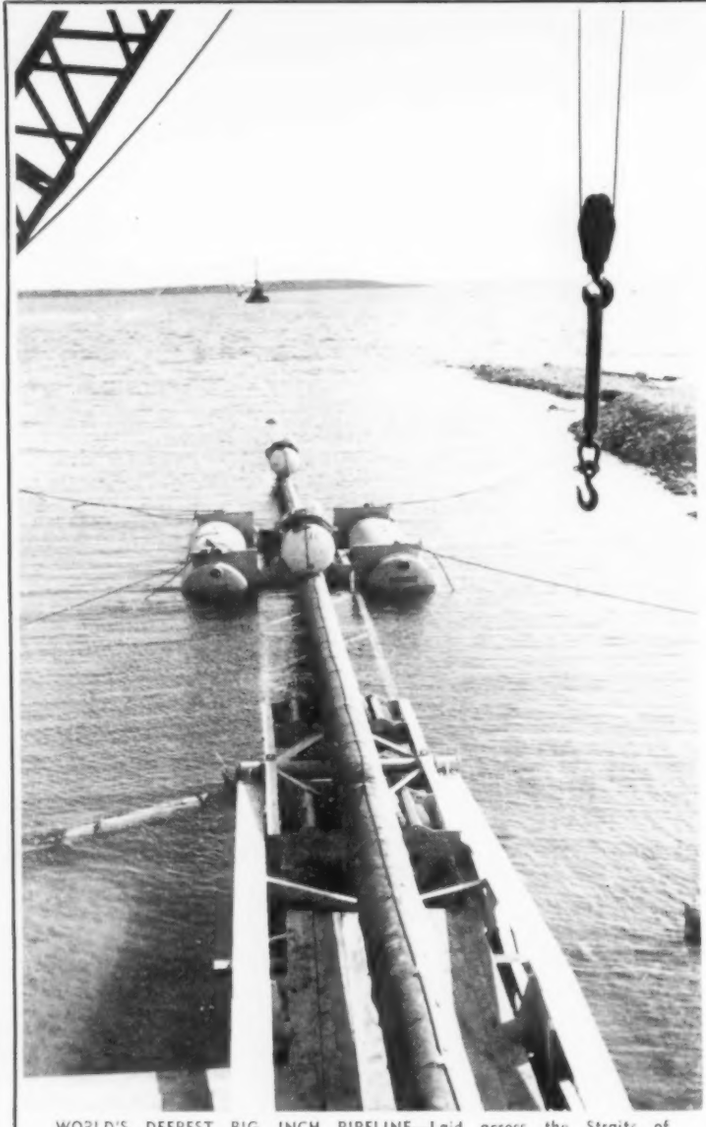

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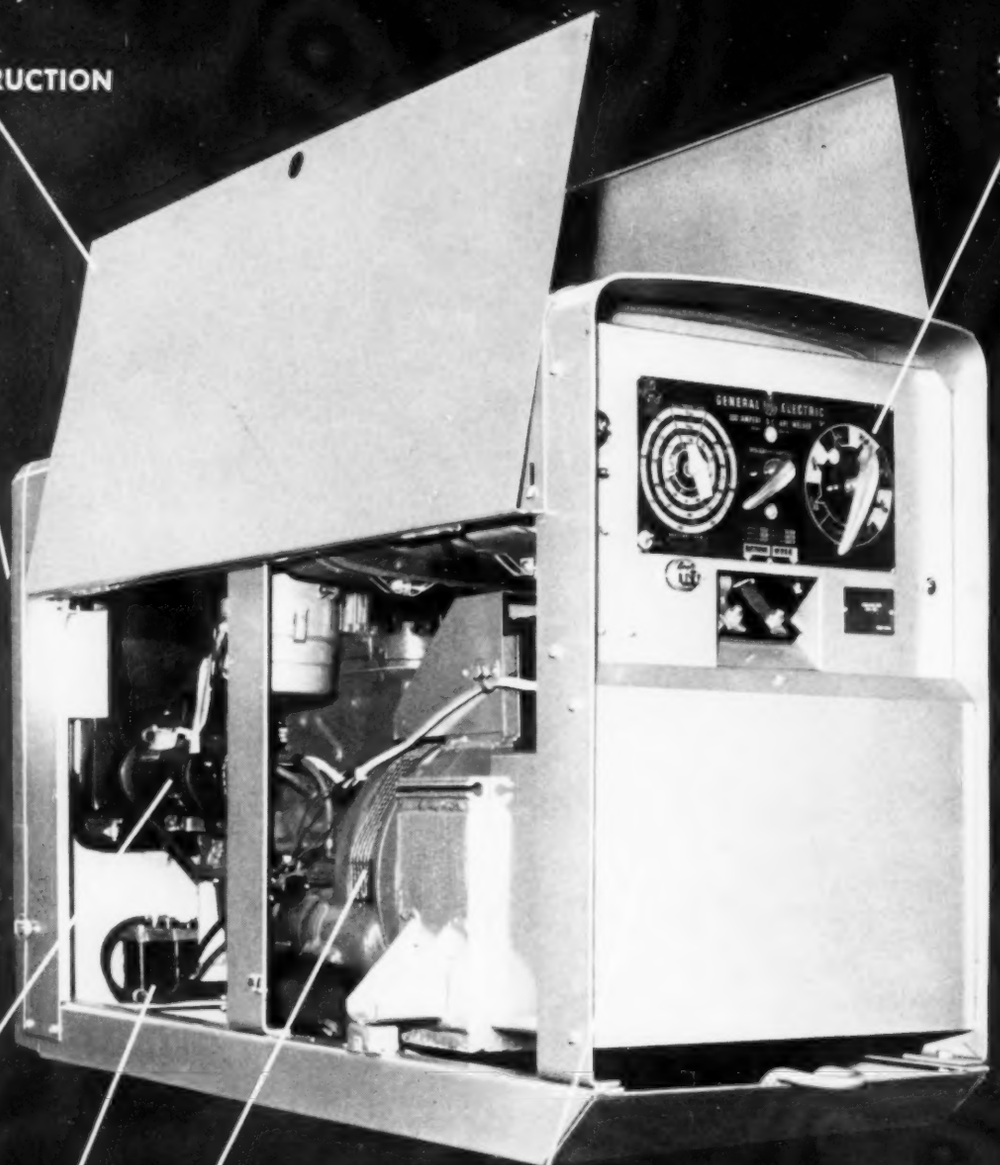

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Advanced design assures less "downtime," minimum maintenance— for faster, lower-cost welding

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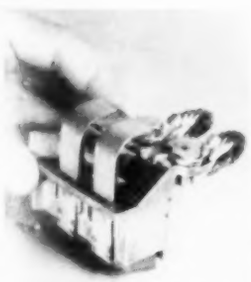

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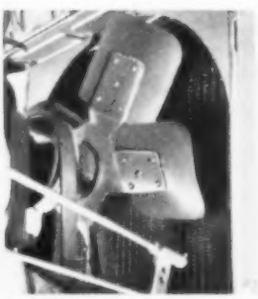

PUSHER-TYPE Engine Fan—Large diameter pusher-type fan circulates ample cooling air for engine and generator.

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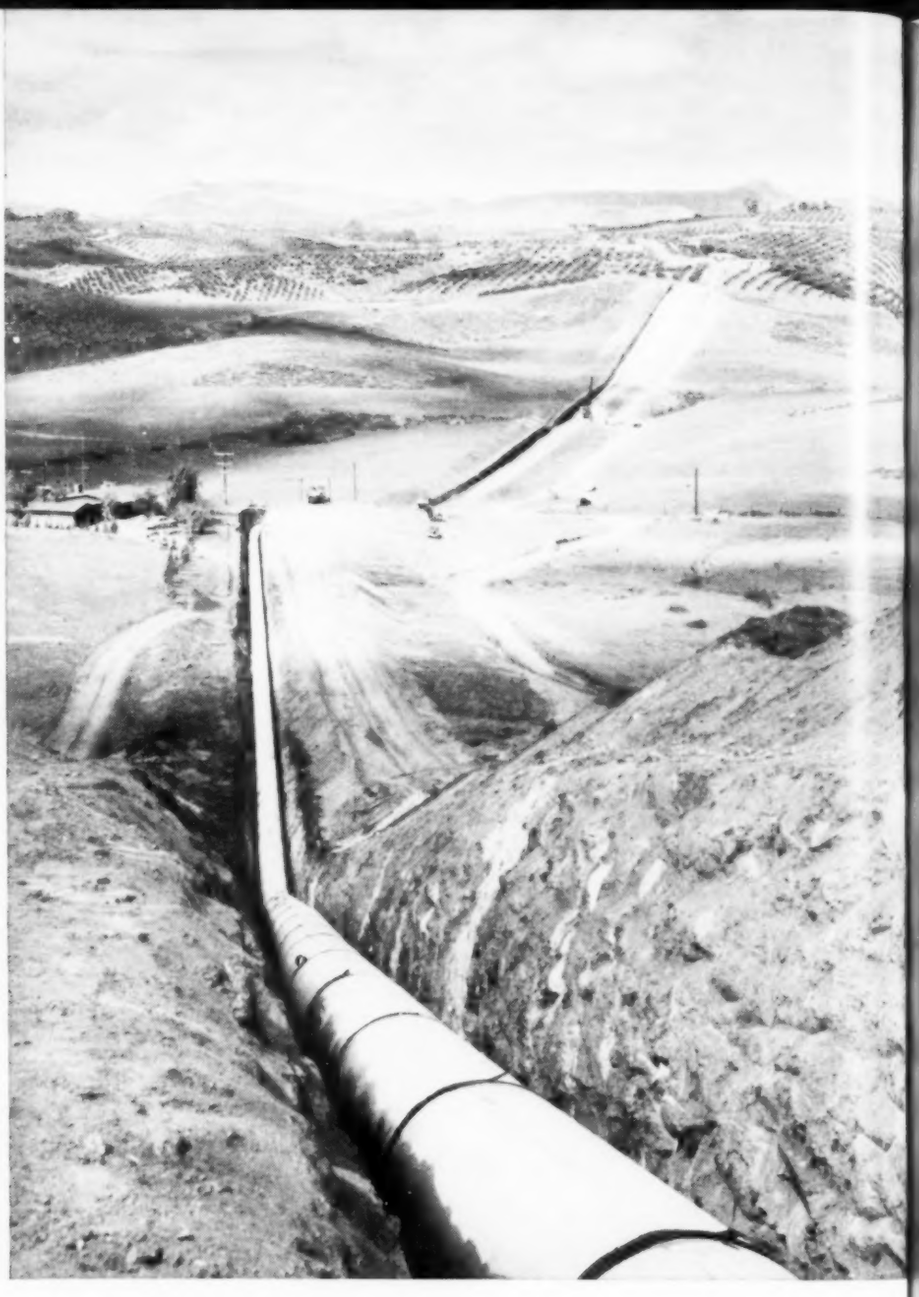
ACROSS HILLS AND VALLEYS

Explosives Research Pays Off



Blasting trenches in hard granite formations to install a pipeline in Southern California called for engineering skill, operating know-how, and a knowledge of explosives.

Over hills and valleys and across rivers and gorges, pipelines provide safe, sure, economical means of transportation for petroleum, natural gas, water, and other mineral resources. When rock is encountered, blasting crews with specialized explosives take over. Here is where explosives research pays off.

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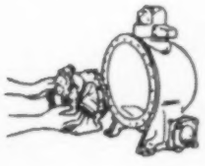

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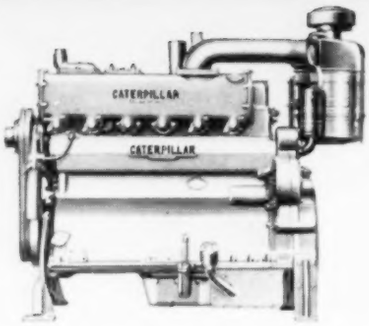

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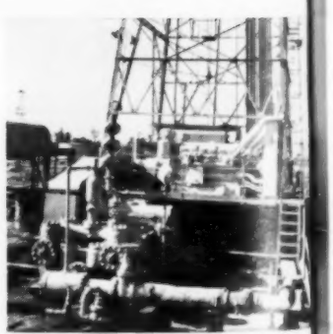

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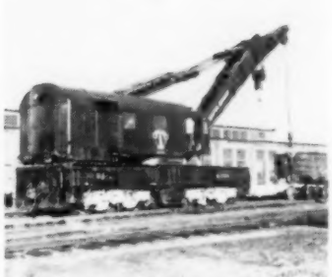
A CATERPILLAR FIRST
—superior lubricants (detergent oils)



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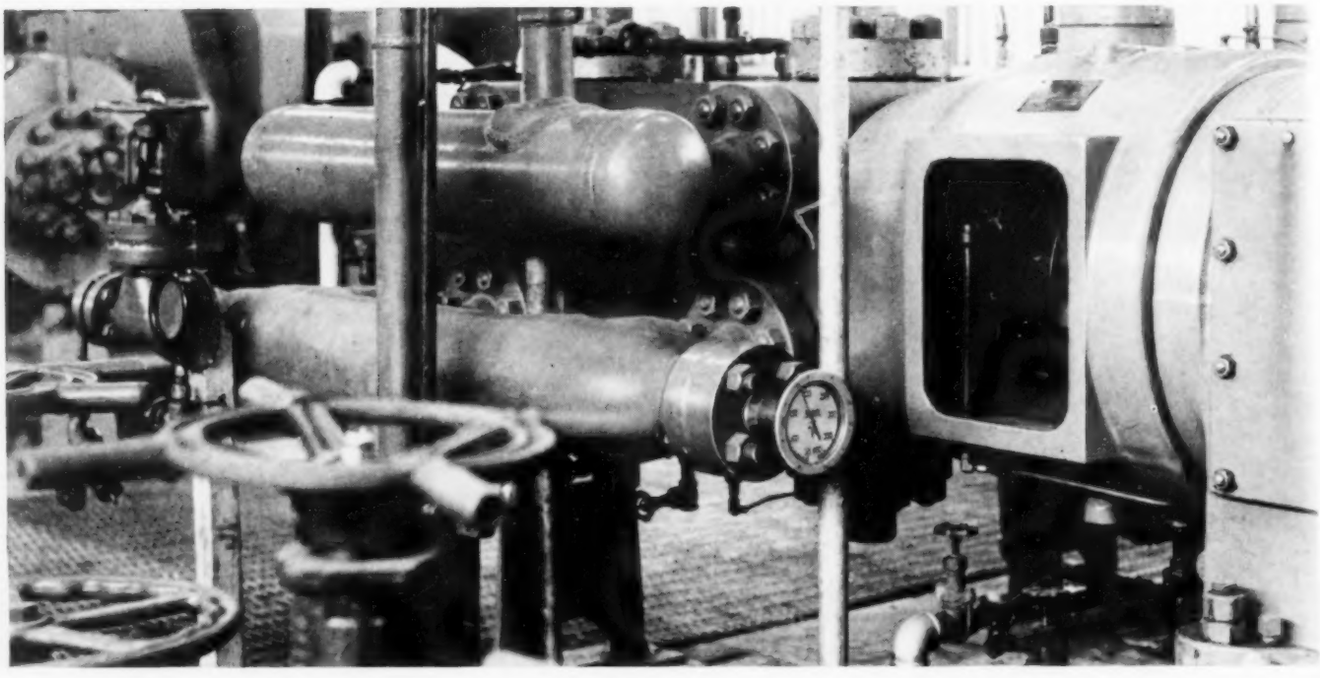


Vibration of refinery compressor proves unshakable accuracy of RMC thermometer

The RMC Thermometer shown in the photograph is constantly subjected to extreme vibration from the two-stage Synthesis Gas Compressor on which it is installed. This powerful equipment is used to compress a mixture of H_2 and N_2 from 400 to 3500 pounds—at the Philadelphia Synthetic Ammonia Plant of The Atlantic Refining Company.

This particular job required a special thermometer that could withstand the constant and terrific vibration, and at the same time provide and maintain precise, accurate readings. Rochester Manufacturing Company promptly came up with the answer—a silicone-dampened, bimetallic, angle-form RMC thermometer. And this is but one example of how RMC engineering skill provides instruments that meet the most demanding and exacting requirements.

Look to RMC for Full-Line Instrumentation

DIAL THERMOMETERS

Illustrated here is a 6" dial thermometer with hermetically sealed dial chamber, external recalibration—built for heavy duty service. What are your thermometer requirements?

PRESSURE SWITCHES

This RMC Pressure Switch will stand heavy pulsating pressures, has close on-off differentials, maintains consistent cut-in, cut-out settings. What are your pressure switch problems?

TELL US YOUR REQUIREMENTS FOR DIRECT MOUNTING AND REMOTE INDICATING INSTRUMENTS, AND LET RMC ENGINEERING SKILL PROVIDE THE ANSWERS!

REPRESENTATIVES IN ALL PRINCIPAL CITIES

RMC

"You Can Rely On Rochester"

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

©1956 Rochester Manufacturing Co., Inc.

ROCHESTER MANUFACTURING CO., INC.
207 ROCKWOOD STREET • ROCHESTER 10, N.Y.

Photo shows convenient panel pull-out drawers

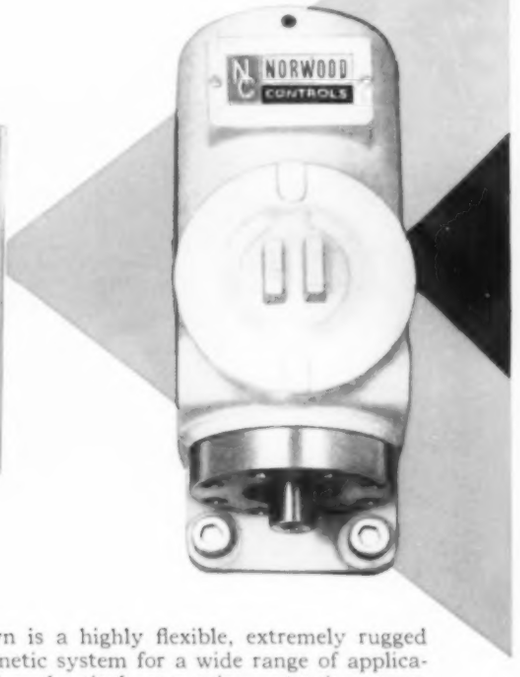
Copyright 1956 by Detroit Controls Corporation

HIGHer reliability
LOWer maintenance

ELECTROSYN

indicating, measuring, recording

SYSTEM



ElectroSyn is a highly flexible, extremely rugged electro-magnetic system for a wide range of applications in the chemical processing, atomic power, natural gas and petroleum transmission fields. It is designed to measure, indicate, record (including analog to digital conversions), or control pressure, differential pressure, flow, liquid level, temperature. Basic system comprised of signal transmitter, servo amplifier (magnetic), and Null Balance Indicator — no electron tubes or slide wires.

Leading pipeline companies are currently using ElectroSyn Systems for remote indication and data handling of pressures and flows. They point out that ElectroSyn is especially practical for pipeline compressor station applications because the system can withstand a static overload of 300% of rated pressure for a 1% zero shift, with a bursting safety factor of ten times rated pressure for ranges up to 1500 psi.

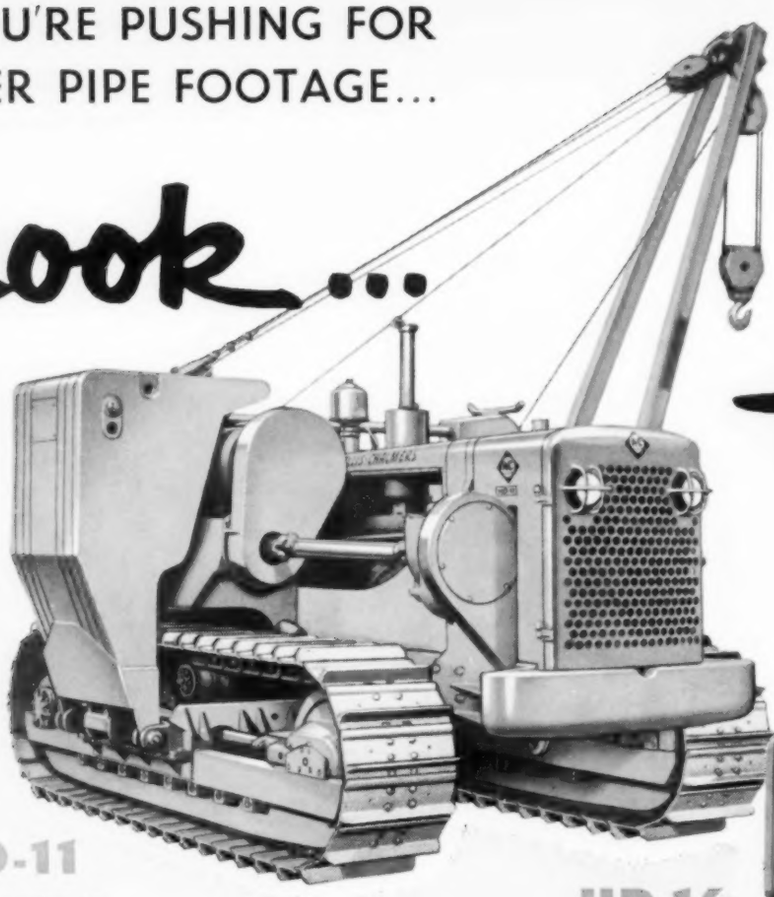
Complete technical information upon request.

NORWOOD CONTROLS
UNIT OF DETROIT CONTROLS CORPORATION
931 Washington Street · Norwood, Mass.

NORWOOD CONTROLS

IF YOU'RE PUSHING FOR FASTER PIPE FOOTAGE...

Look... to the line...



HD-11

99 net engine hp

Weight — 34,131-lb tractor and side boom with full counterweight

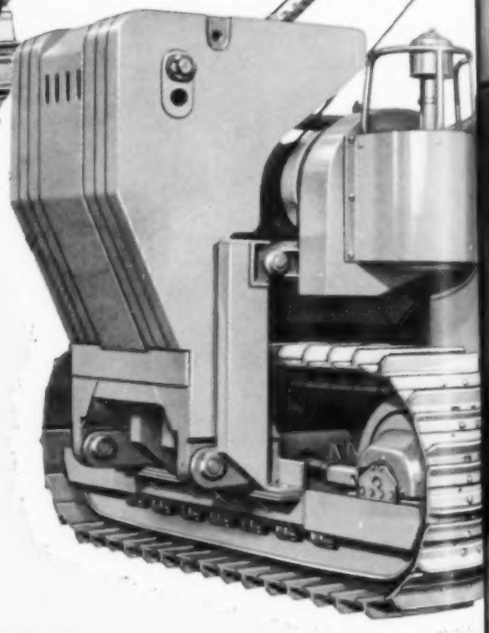
40,200-lb lifting capacity at 4-ft overhang

HD-16

150 net engine hp

Weight — 57,840-lb tractor and side boom with full counterweight

77,580-lb lifting capacity at 4-ft overhang



• A SIZE FOR ANY JOB

Big inch or small, there's an Allis-Chalmers tractor-Tractomotive side boom to handle the job. The powerhouse HD-21 has proved itself on 36-in. and bigger pipe. The new HD-16 not only speeds work on medium-size pipe, but has pleased owners with its ability to handle the big pipe as well. The HD-11 handles feeder, distribution and smaller inch jobs . . . is ideal on the big lines for handling pipe sections for welders and bending gangs. This crawler tractor-side boom combination also has wide application for maintenance, repair and take-up on existing lines.

• IN STEP WITH TODAY

Here is a line of tractor-side booms that gives you the latest in design advantages: new Allis-Chalmers diesel engine — new design torque converter drive . . . new long-life track and heavy-duty roller bearing truck wheels . . . new power train with big reserve capacity PLUS all-steel box-A main frame; straddle-mounted final drive gears; 1,000-hour lubrication of truck wheels, idlers and support rollers; oil-enclosed track release mechanism.

High clearances underneath both tractor and counterweight permit moving over obstacles and operating efficiently under roughest conditions.

• SAFE, HUSKY TRACTOMOTIVE SIDE BOOM

Side boom features drop-proof safety counterweights . . . internal expanding brakes, fully enclosed from dirt and moisture . . . easy-working, convenient controls . . . and constant-mesh transmission. Heavy-duty box-section construction gives booms plenty of strength to utilize tractor lifting capacity and handle peak pipe loads.

• GET THE FACTS — FIRSTHAND

See your dealer for full information on the new line of Allis-Chalmers crawler tractor-Tractomotive side boom combinations. It's the line for the big pipe jobs of today — and tomorrow.

ALLIS-CHALMERS

ALLIS-CHALMERS CRAWLER TRACTORS

TRACTOMOTIVE SIDE BOOMS

Pipeliners are known for their eager acceptance of new ideas, techniques and equipment. The result is bigger, better pipe lines at record speeds — in spite of rivers, mountains, deserts and bad weather conditions. And it's this pipeliner desire for better ways of doing things that's putting more and more Allis-Chalmers tractors with Tractomotive side booms on pipe-line spreads all over the world. These units are the most modern, advanced design tractor-side booms a pipeliner can use.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

# of advanced design

HD-21

204 net engine hp
Weight — 78,250-lb tractor and side boom with full counterweight
127,000-lb lifting capacity at 4-ft overhang

TRACTOMOTIVE CORPORATION

DEERFIELD, ILLINOIS

Pipeline protection from rust and corrosion costs so little with **UNICOR**®

The pipeline operators who use Unicor, UOP's oil-soluble corrosion inhibitor, not only get dependable protection but get it at surprisingly little cost. Such minute concentrations are required that Unicor's cost is only about $0.0005/bbl. of pipeline product.

Actually, only one molecule of Unicor is required for every million molecules of gasoline. Additional savings, too, from much reduced scraper cleaning and filter replacement costs.

Unicor is completely dependable. It prevents rusting in product pipelines at a typical concentration of 10 ppm. Addition is required at only one point and since it is distributed uniformly over the entire internal surface, protection is virtually 100% effective.

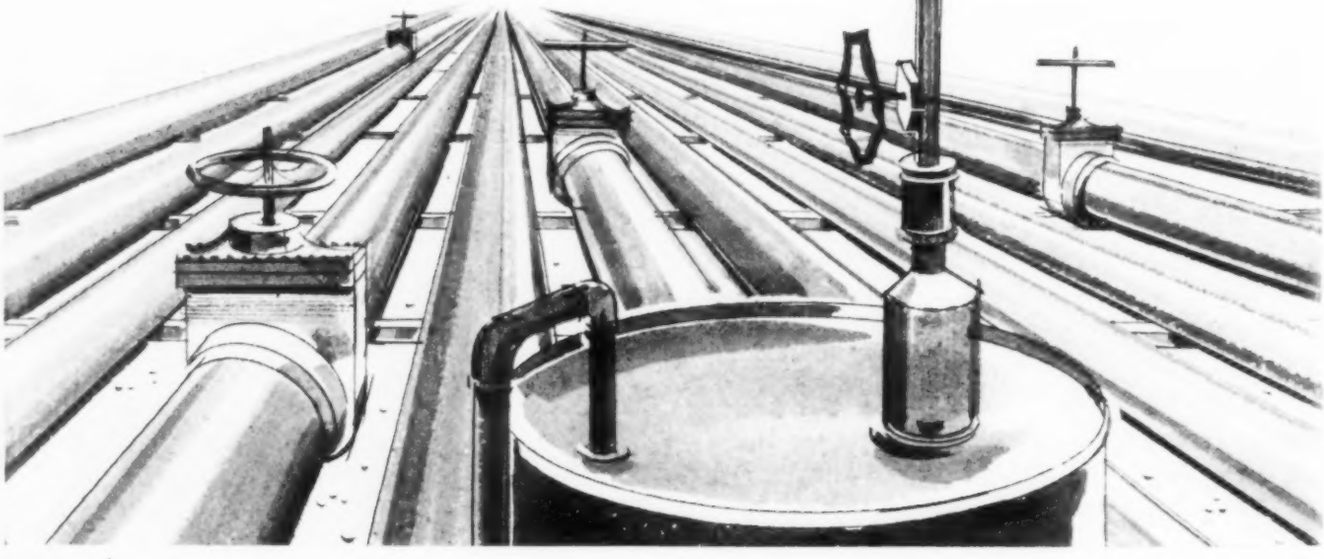
The services of our technical specialists are available to assist you in the design, installation and operation of a Unicor system of protection. Write us for samples and information.

PRODUCTS DEPARTMENT

UNIVERSAL OIL PRODUCTS COMPANY

UOP

30 ALGONQUIN ROAD
DES PLAINES, ILLINOIS, U. S. A.



WHAT DO YOU LOOK FOR IN PIPELINE VALVES?

Positive Shut-Off?

Rockwell-Nordstrom valves are lubricant sealed for *positive, continuous* shut-off on heavy crudes or light gases.

Fast Operation?

Rockwell-Nordstrom valves close with just a quarter-turn. Pressurized lubricant makes operation smooth, easy . . . jacks the plug for *instant* operation.

Clean Design?

Rockwell-Nordstrom valves have *no bonnet or body cavities* to collect valve jamming sediment. Flow is clean as a whistle . . . minimum pressure drop.

Low Maintenance?

Rockwell-Nordstrom valves have *no exposed seats* to wear out . . . lubricant reduces wear for longer life at lower cost.

Versatility?

Rockwell-Nordstrom valves are available in sizes to 30", API ratings to 10,000 lb. They can be ordered with wrench, gear or power operators to fit any need.

Low Cost?

Rockwell-Nordstrom valves cost no more to buy than ordinary valves. And they *stay* reliably on stream at *lower* cost than *any* other valve.

You get all the performance and economy you look for in pipeline valves when you specify "Rockwell-Nordstrom." Get the complete story from your nearby supplier, or write Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

Lubricant Sealed For Positive Shut-Off

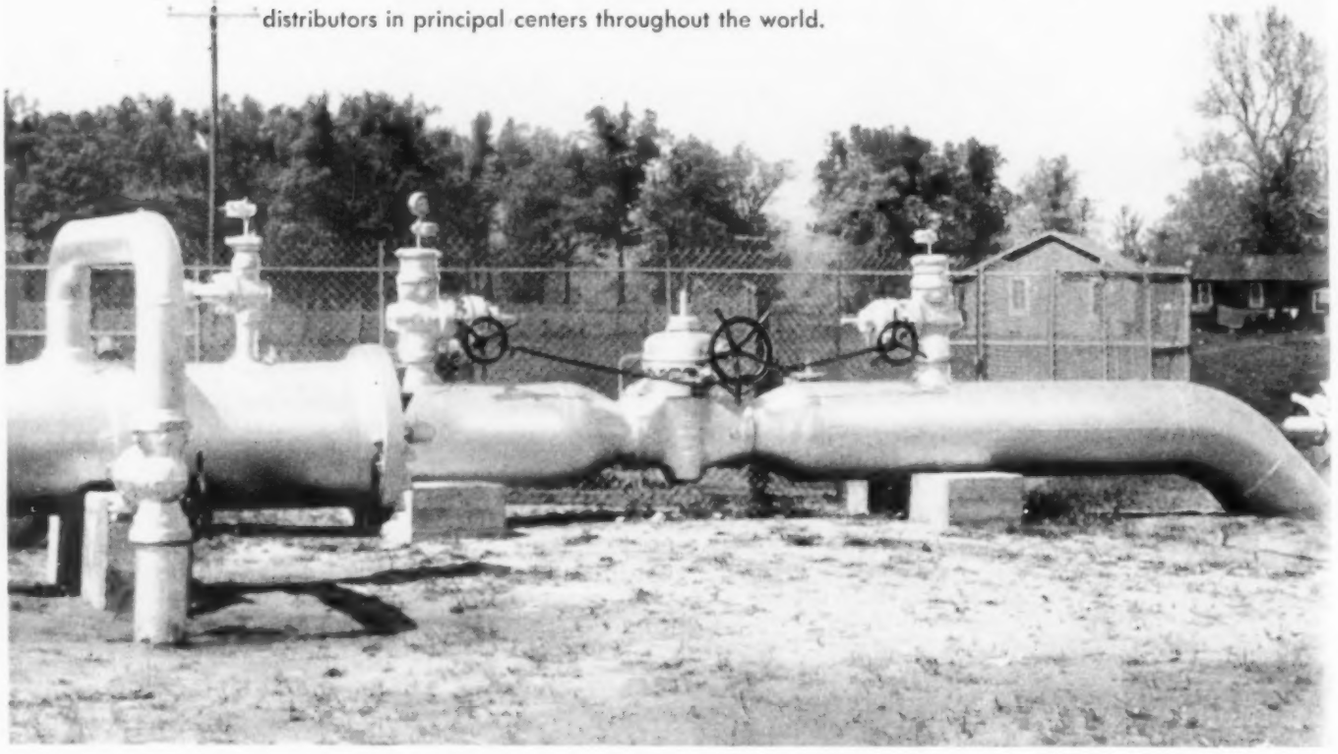
40th YEAR *of lubricated plug valve leadership*

MAJOR PIPELINES EVERYWHERE

are served better by the very best...
Walworth Lubricated Plug Valves

Walworth Cast Steel Lubricated Plug Valves enjoy a long record of successful service on pipelines the world over. In design, construction and performance they stand unsurpassed.

Other Walworth products include Gate, Globe, Angle and Check Valves in a wide range of types and sizes for the oil and gas industries. Sold by distributors in principal centers throughout the world.



WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALLOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION M&H VALVE & FITTINGS CO. SW SOUTHWEST FABRICATING & WELDING CO., INC. W WALWORTH COMPANY OF CANADA, LTD.

EACH year an overwhelming majority of pipeline owners and operators select *coal tar* coatings to protect their long-term investment. And with good reason: No other material can match coal tar coating's *proven* record of economical, long-lasting protection.

Coal tar coatings are amazingly durable. And their life is measured in decades—thanks to their inherent ability to resist soil stress and water absorption, the two big reasons why other materials fail.

If you'd like to be sure of the *best* pipeline protection that money can buy, specify *Pitt Chem* Coal Tar Coatings, just as scores of leading pipeline companies do. When you buy *Pitt Chem*, you buy *assured* pipeline protection with every drum, because *Pitt Chem* Coal Tar Coatings are manufactured to rigid, *published* specifications by a basic producer. If *you* have a pipeline protection problem, chances are we have the answer. *A phone call will place an experienced Pitt Chem man at your service.*

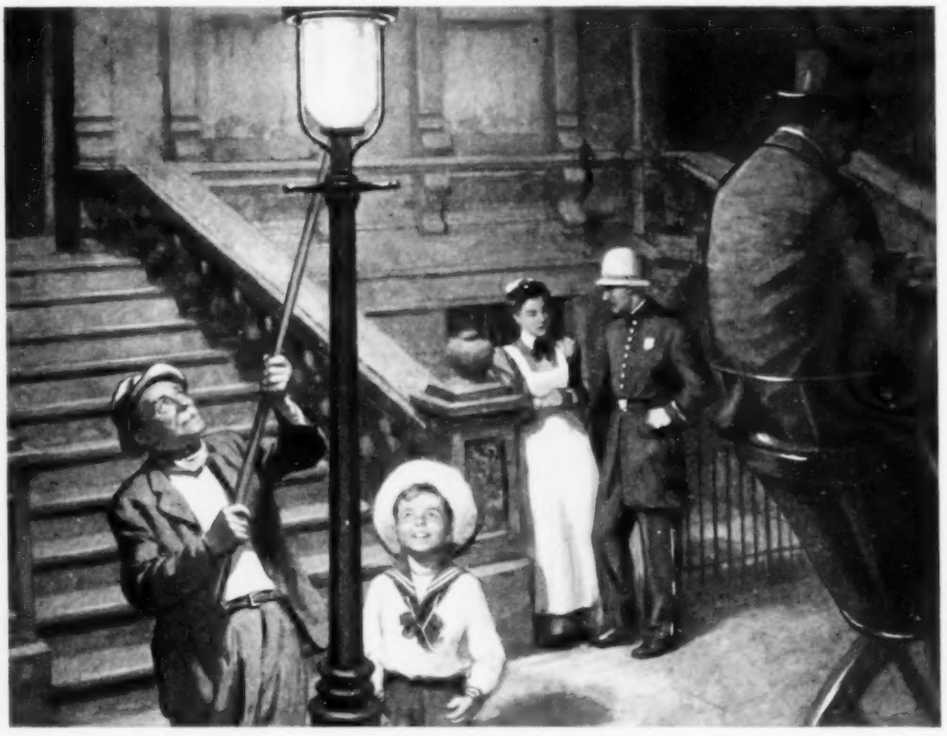
PITT CHEM® TAR BASE COATINGS

Standard Grade Modified Grade
Plasticized Grade Hotline
Cold Applied Tar Base Coatings

PROTECTIVE COATINGS DIVISION
PITTSBURGH COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

WAD 5895

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON



gas has come a long way...

50 years ago . . . a yellow haze in the streets.

Today, natural gas is a 14 billion dollar industry . . .
the nation's sixth largest. Serving 100 million people . . .
over a hundred thousand industrial plants.
Supplying one quarter of the nation's heat and energy.
Made possible by pipeline transportation.

Tennessee Gas, the nation's longest pipeline,
brings nature's finest fuel from the gas-producing
Southwest to the densely populated East.

Hauls it safely, cheaply, dependably . . . 2200 miles across
15 states . . . a long way to serve America.

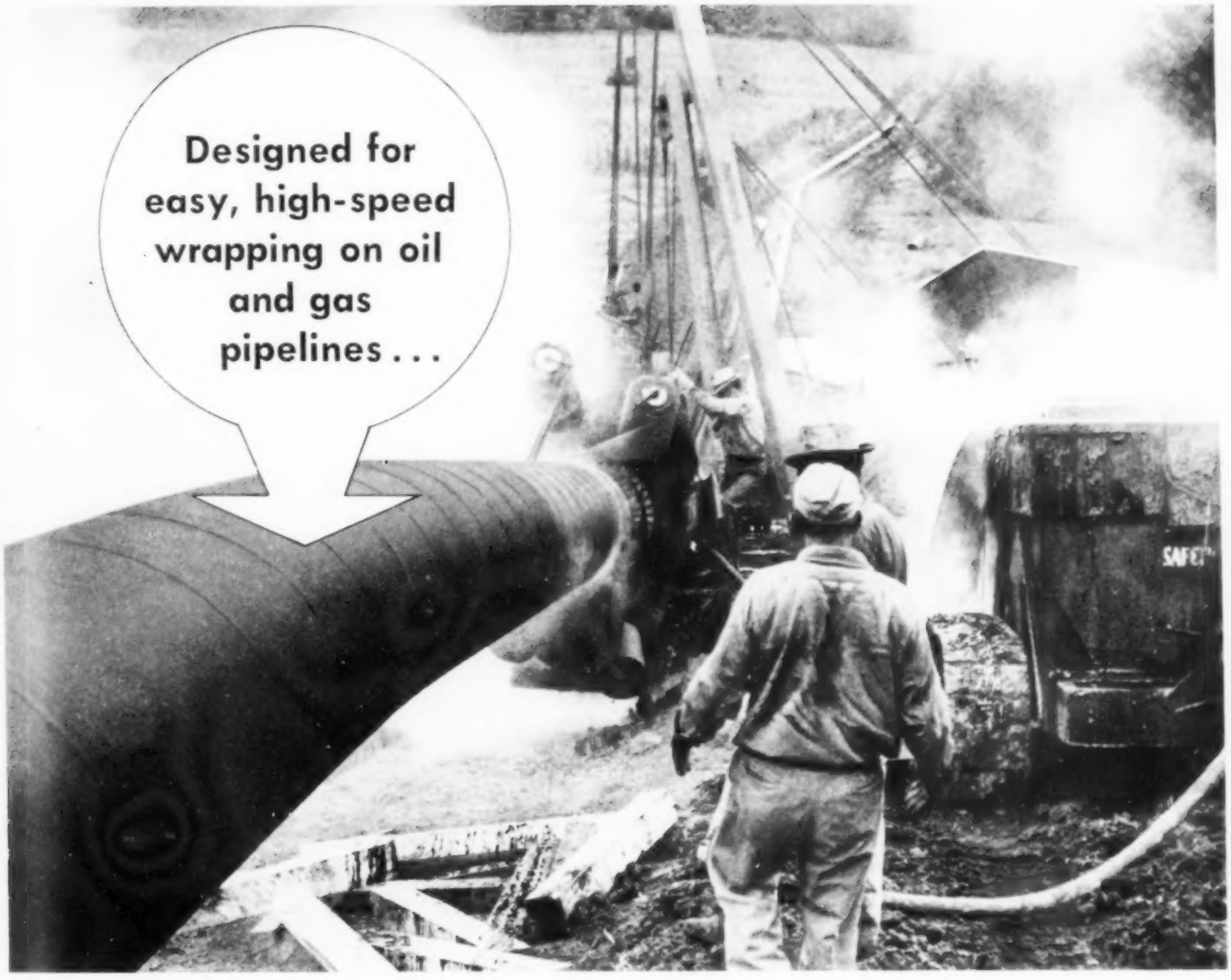
Today natural gas, shipped by long distance pipeline to millions of homes, enables modern gas appliances to provide easier, healthier living throughout America.

TENNESSEE GAS
TRANSMISSION COMPANY
AMERICA'S LEADING TRANSPORTER OF NATURAL GAS
HOUSTON, TEXAS

One of a series of advertisements appearing in full color in national publications.

And keeps going places . . . Advertisements like this tell the public about the constantly expanding service provided by the natural gas industry . . . point out the great strides made in assuring adequate supplies and the modern convenience of gas to millions.

TENNESSEE GAS TRANSMISSION COMPANY
HOUSTON, TEXAS



Johns-Manville TRANSHIELD® ASBESTOS PIPE LINE FELT

goes on fast, restricts soil stress, cuts maintenance

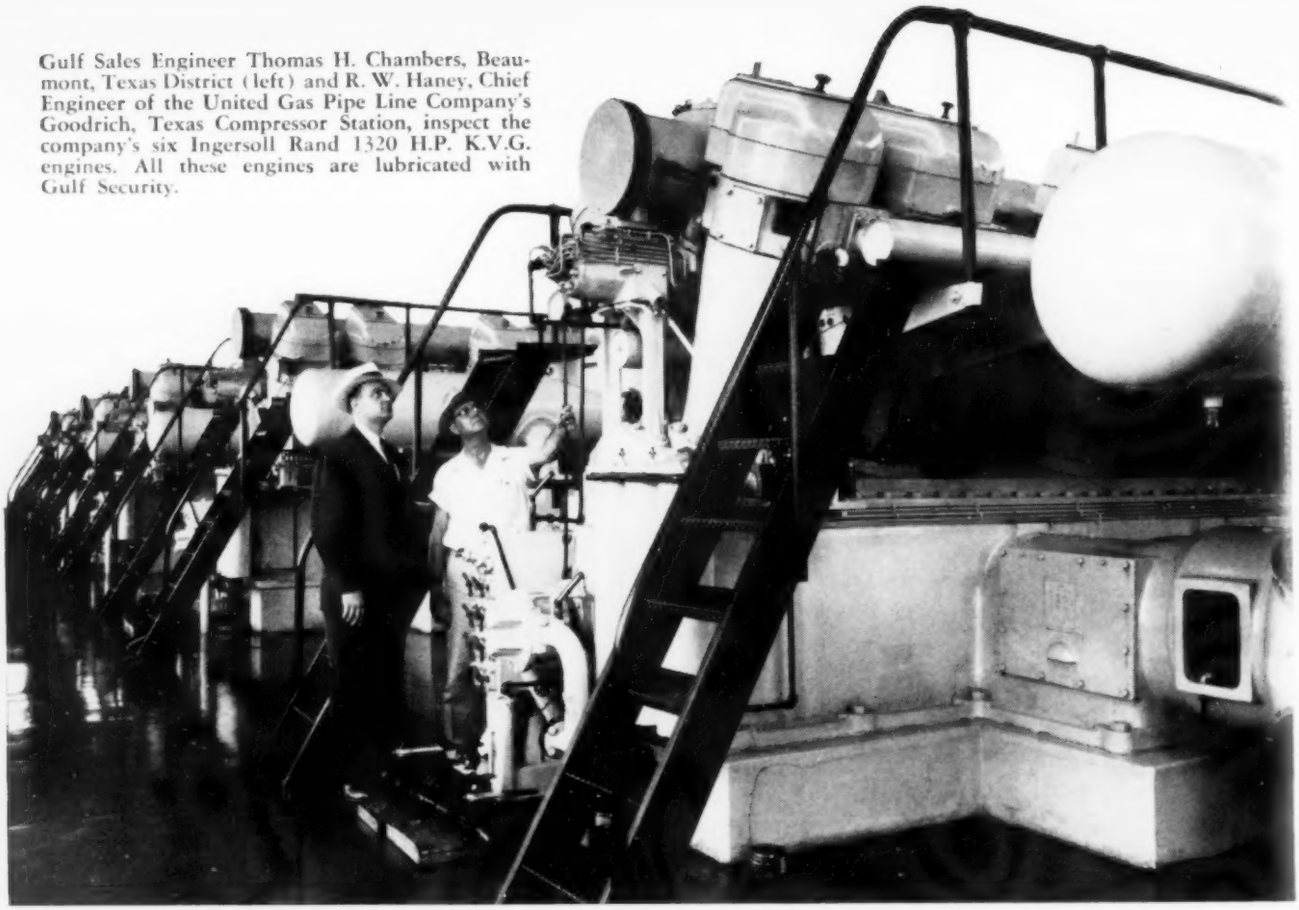
ON job after job, pipe line men have found that Transhield Asbestos Pipe Line Felt meets the need for an economical asbestos shield that is effective in average soil conditions.

Contractors like Transhield because its special reinforcement makes it ideal for easy, high-speed application by modern machine methods. Consisting of a lightweight coal-tar-saturated asbestos felt, it is reinforced with continuous glass yarns parallel-spaced on ¼″ centers. Transhield's light weight permits the use of 800-ft. rolls which increases application speeds since fewer stops for roll changes are required.

Transhield provides a continuous membrane between the pipe line enamel and the soil. It works effectively in preserving a continuous protective film of enamel on the pipe. During construction, it guards the enamel. After installation, it reduces the cold flow of the enamel, and acts as a surface barrier to restrict soil stress.

For further information write to Johns-Manville, Box 60, New York 16, N. Y.; in Canada, 565 Lakeshore Road East, Port Credit, Ontario.

Johns-Manville PRODUCTS FOR PIPE LINE PROTECTION



Gulf Sales Engineer Thomas H. Chambers, Beaumont, Texas District (left) and R. W. Haney, Chief Engineer of the United Gas Pipe Line Company's Goodrich, Texas Compressor Station, inspect the company's six Ingersoll Rand 1320 H.P. K.V.G. engines. All these engines are lubricated with Gulf Security.

Lock out high maintenance costs in your gas transmission plants

with GULF SECURITY

Gulf Security's outstanding record in the lubrication of pipeline gas engine compressor units is your assurance of smooth, continuous operation. In scores of gas transmission plants this high quality straight mineral oil helps prevent operating troubles and contributes to low maintenance costs.

Gulf Security is a non-additive oil that does not cloud liquid filled lubricators of power cylinders, compressor cylinders, and packing glands. After years of operation with Gulf Security, cylinders and piston rings of both compressors and power assemblies show negligible wear, and its excellent oxidation stability helps prevent the formation of acid and resins in the crankcase system.

Make certain your units receive safe, effective lubrication protection—specify Gulf Security. And remember that Gulf provides the services of a trained, experienced petroleum expert—the Gulf Sales Engineer—to help you with any problem involving a petroleum product. Consult the telephone directory for the number of your nearest Gulf office.

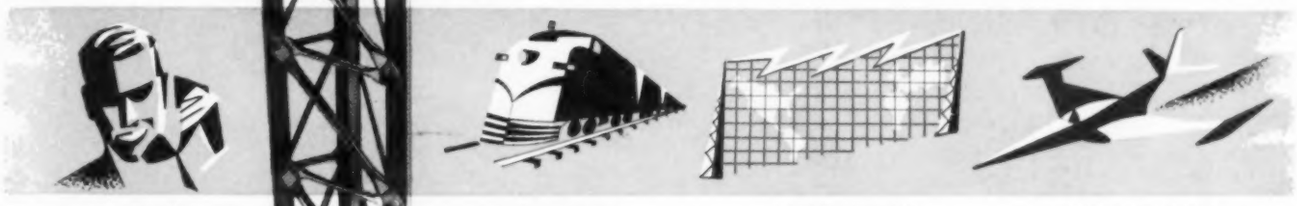
GULF

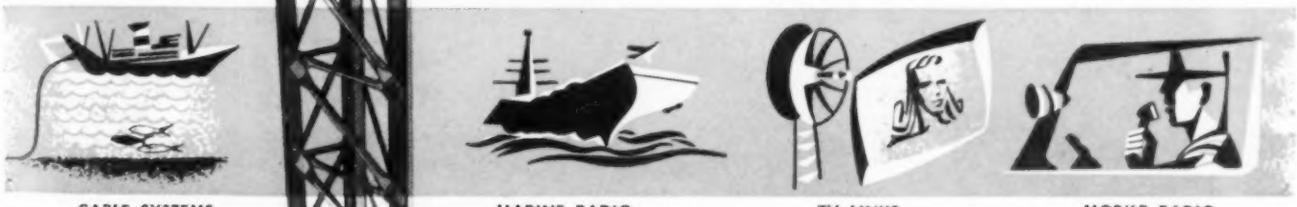
Gulf Oil Corporation • Gulf Refining Company
1822 Gulf Building, Pittsburgh 30, Pa.

THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

Behind *Federal* MICROWAVE

—the world's most comprehensive communications experience





Federal, through IT&T's global background in research, engineering, manufacturing and system operation, brings you... "MICROWAVE AT ITS BEST"

No other microwave system is backed by communications experience so broad and diversified as that of Federal's parent company . . . the world-wide International Telephone and Telegraph Corporation.

IT&T *pioneered* microwave . . . IT&T *knows* communications . from the simplest inter-office dial telephone system to intercontinental radio and cable companies serving every corner of the earth. This vast, collective experience, covering system *manufacturing* and system *operation*, is the *plus value* you get *only* with Federal Microwave!

Federal is the system especially designed for pipelines, railroads, utilities, telephone companies, municipalities, highways, TV stations and others . . . meeting every need for high-quality operation of communications, supervisory and control functions.

Whatever your distance, terrain or circuit requirements . . . look to Federal for microwave systems of maximum versatility and dependability . . . built by communications experts . . . and *"Certified by a World of Research."*

Write to Dept. H-8153

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Federal Telephone and Radio Company
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WHEN
PERFORMANCE - QUALITY - TIME
really COUNT

Modern methods, the finest up-to-date equipment, and well-trained experienced, year 'round crews take over every job with these three things in mind — performance, quality, and time — fulfilling our contractual obligations to your complete satisfaction. All your pipeline operations begin well ahead of schedule when you contract with H. B. Zachry Company.

H.B.ZACHRY CO.

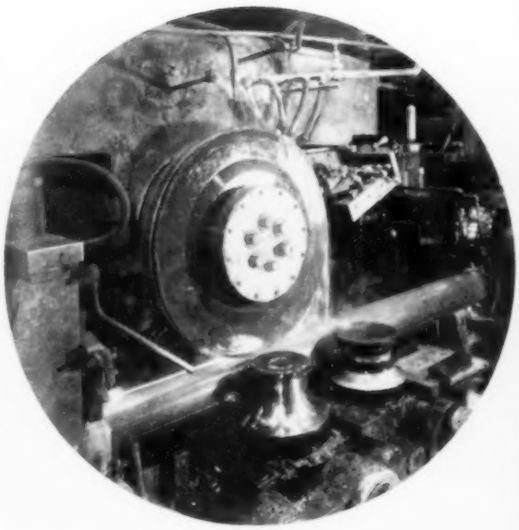
GENERAL CONTRACTORS

PIPE LINE DEPT.
TRANSIT TOWER
SAN ANTONIO, TEXAS

Acme-Newport Steel

4" and 6" LINE PIPE*

Made Right...Formed Right...Sold Right



*SIZES AND WEIGHTS AVAILABLE

O.D.	Wall	Wt. Per Ft
4½	.125"	5.84
	.142"	6.61
	.156"	7.25
	.188"	8.64
	.219"	10.00
	.237"	10.79
6⅝	.134"	9.29
	.156"	10.78
	.188"	12.89
	.219"	14.97
	.250"	17.02
	.280"	18.97

ECONOMICAL WATERAIL-TRUCK DELIVERY

Acme-Newport has the experience and facilities to produce small size electric weld line pipe of great strength and long life. From electric furnace to final rolling, this product conforms to API and ASTM specifications—carefully formed, correctly welded, and hydrostatically tested. To all this add the mill's location on the great Mississippi-Ohio waterway, for convenient, economical delivery, and you have every good reason to make Acme-Newport your regular source for line pipe or any other of the products listed below.

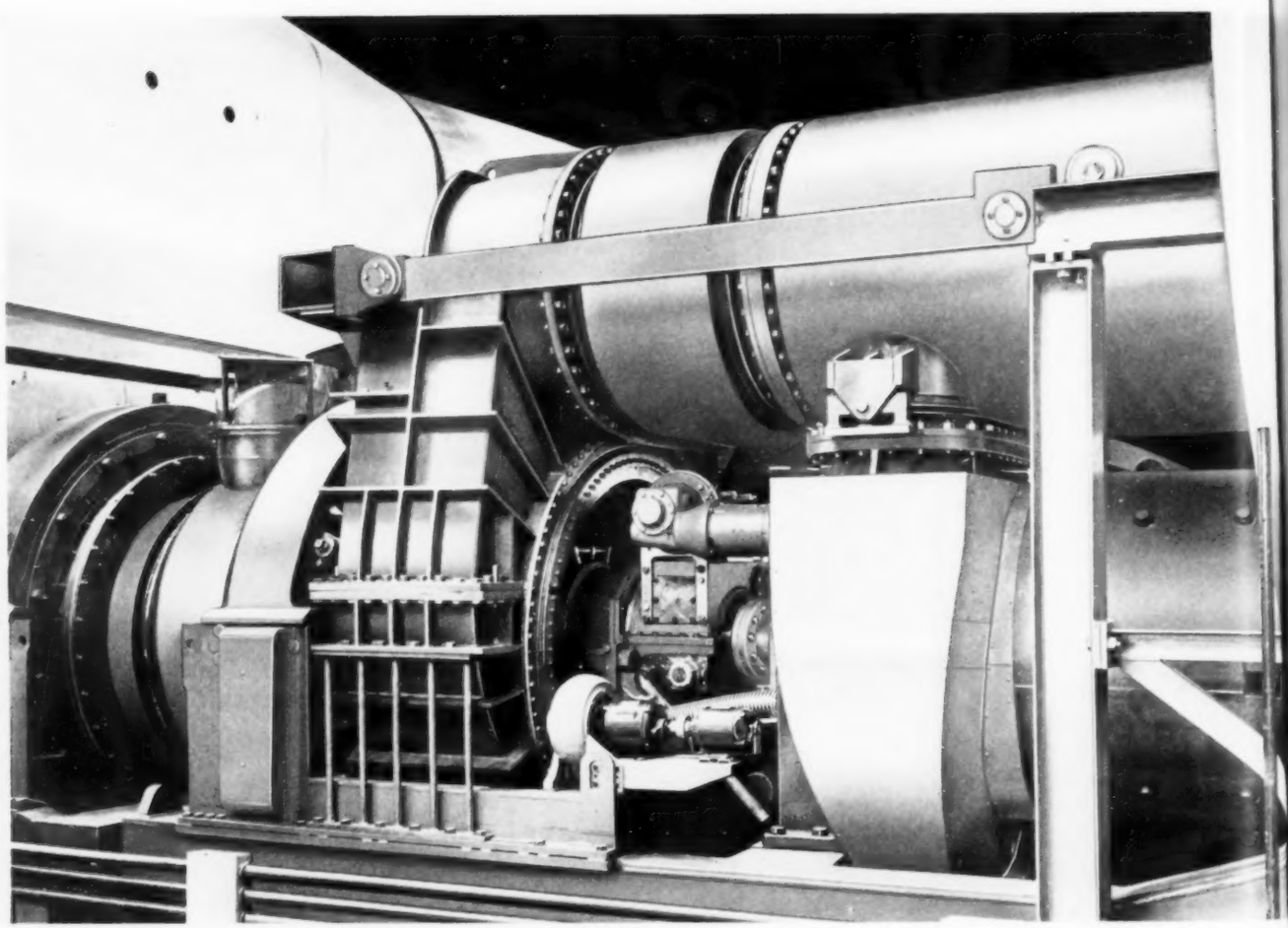
Acme-Newport Steel COMPANY

NEWPORT, KENTUCKY

A SUBSIDIARY OF ACME STEEL COMPANY

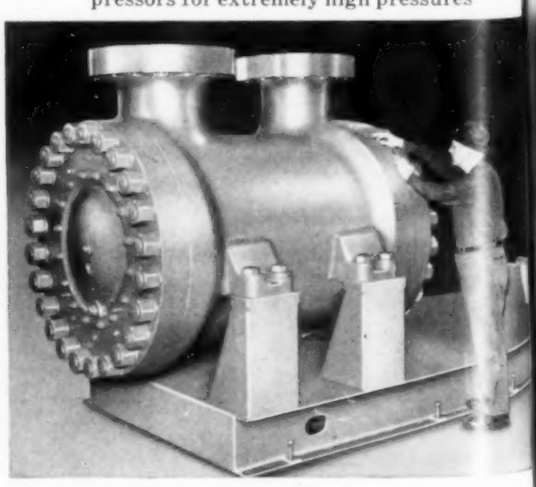
Cold-Rolled Sheets • Hot-Rolled Steel in Coil • Hot-Rolled Pickled Steel in Coil • Hot-Rolled Sheets • Hot-Rolled Pickled Sheets
Electrical Sheets • Alloy Sheets and Plates • Electric Weld Line Pipe • Eave Trough and Conductor Pipe • Culverts

GAS TURBINES



Clark 8500 BHP Gas Turbine for centrifugal compressor, generator or pump drive

Clark Barrel Type Centrifugal Compressors for extremely high pressures



CLARK®

GAS TURBINES
CENTRIFUGAL COMPRESSORS

CENTRIFUGAL COMPRESSORS
Only CLARK builds both!

Now you can get centrifugal compressors and modern gas turbines to drive them *exclusively* from one manufacturer . . . Clark.

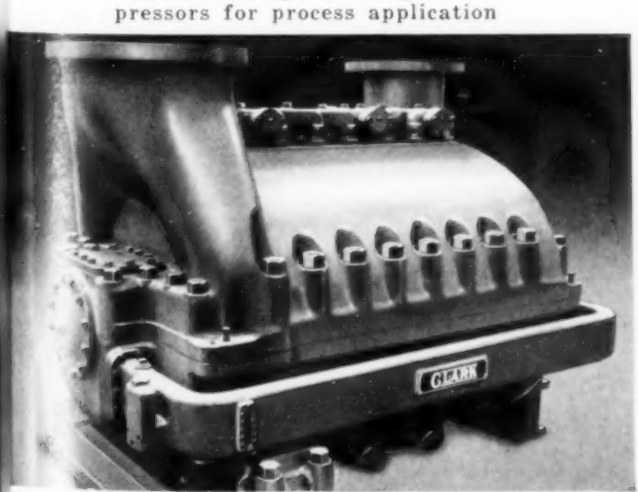
In addition to saving money and headaches, you'll get proved, matched-performance "packages" specifically designed for continuous trouble-free service.

Whether you have a million or a billion cubic feet of air or gas per day to handle at pressures of up to 4500 pounds per square inch, there is a Clark centrifugal compressor and in most cases a matching Clark gas turbine to drive it.

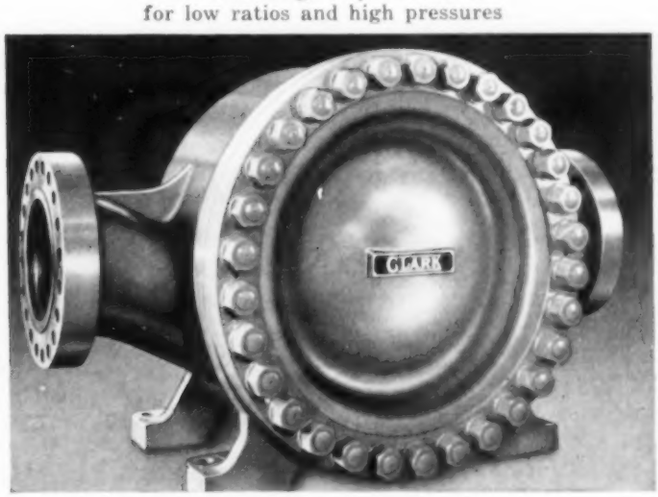
Your nearest Clark representative will be pleased to give you all the facts.

CLARK BROS. CO., OLEAN, N. Y.
One of the Dresser Industries
Offices in Principal Cities throughout the World

Clark Multi-Stage Centrifugal Compressors for process application



Clark Centrifugal Pipeline Booster for low ratios and high pressures



Hourly pressure information is transmitted from Northern Natural Gas Company compressor and field dispatch station to chief dispatcher's office in Omaha, Nebraska, by Bell System private line telephone.

How they protect 800,000 homes from a sudden temperature drop

There's a sudden drop of temperature in the Dakotas—and dispatchers of the Northern Natural Gas Company swing into action—to assure normal gas pressures for local distributing companies serving 800,000 domestic users through 10,000 miles of pipeline all the way from New Mexico to Minnesota!

Dispatchers, using Bell System private line telephone facilities, ask certain large industrial users to switch temporarily to other fuels.

Then, through contact with 35 compressor stations by telephone, dispatchers at Omaha headquarters direct the additional gas thus gained to the desired localities. A potential emergency is handled in stride, thanks to modern communications.

. . .

The Bell System welcomes the opportunity to help you obtain the most reliable and economical communications facilities. Call your Bell System representative.

BELL TELEPHONE SYSTEM

PRIVATE LINE TELEPHONE • PRIVATE LINE TELETYPEWRITER

CHANNELS FOR: DATA TRANSMISSION • TELEMETERING • REMOTE CONTROL • TELEPHOTOGRAPH • CLOSED CIRCUIT TV

PIPE LINE PANORAMA

Pipe Line Expansion Continues Torrid Pace . . . Pipe line expansion activity reached near-record peak in October. Brief review of expansion plans, studies and FPC approvals include:

California Standard and Shell are considering 600-mile, 14-inch crude line from Four Corners area of Utah, Arizona, New Mexico, and Colorado to Los Angeles. Capacity would range from 50,000 bpd at start to ultimate of 100,000 bpd. Time to build: Two years.

Products line from Salt Lake City to Spokane, Wash. is being discussed by four majors. Line would be laid by Service, Continental, Sinclair and Phillips. Salt Lake Pipe Line now operates line parallel to one being considered.

Despite strong protests from coal interests and Pittsburgh city officials, FPC gave Texas Eastern green light to: (a) Import up to 200,000 Mcf/d of natural gas from Mexico. (b) Build 707 miles of gas line—and add 32,200 hp in new and existing compressor stations. Estimated cost: $82.7 million.

On October 29, FPC again began hearings on second phase of Texas Eastern's expansion and diversification program. If project is approved, company will reconvert major segment of Little Big Inch line to products service. Earlier FPC approval was set aside by the courts. Total cost of Mexican and Little Big Inch projects: $147 million.

Houston Natural Gas will purchase Houston Pipe Line Corp. from Atlantic Refining. Total cost: $37.7 million. New acquisition will give Houston Natural 1.5 billion Mcf of gas reserves.

•

Report on Pipe Shortage . . . Major steel companies paint bleak picture for line pipe in coming months. This is what they have to say: **Buttweld**—Small orders sold out through December. Many mills refuse to take large orders—are splitting them into quarterly deliveries. **Lapweld**—Small orders sold out through January, '57. Same as buttweld on large orders. **Seamless**—Small order deliveries some time in first quarter of '57. Large orders sold out through '59—some mills not even taking orders. **Electric Weld**—Sold out through '57, say some of the mills.

Steel company requests for fast tax write-offs to expand pipe making facilities will not be approved until after elections—if at all.

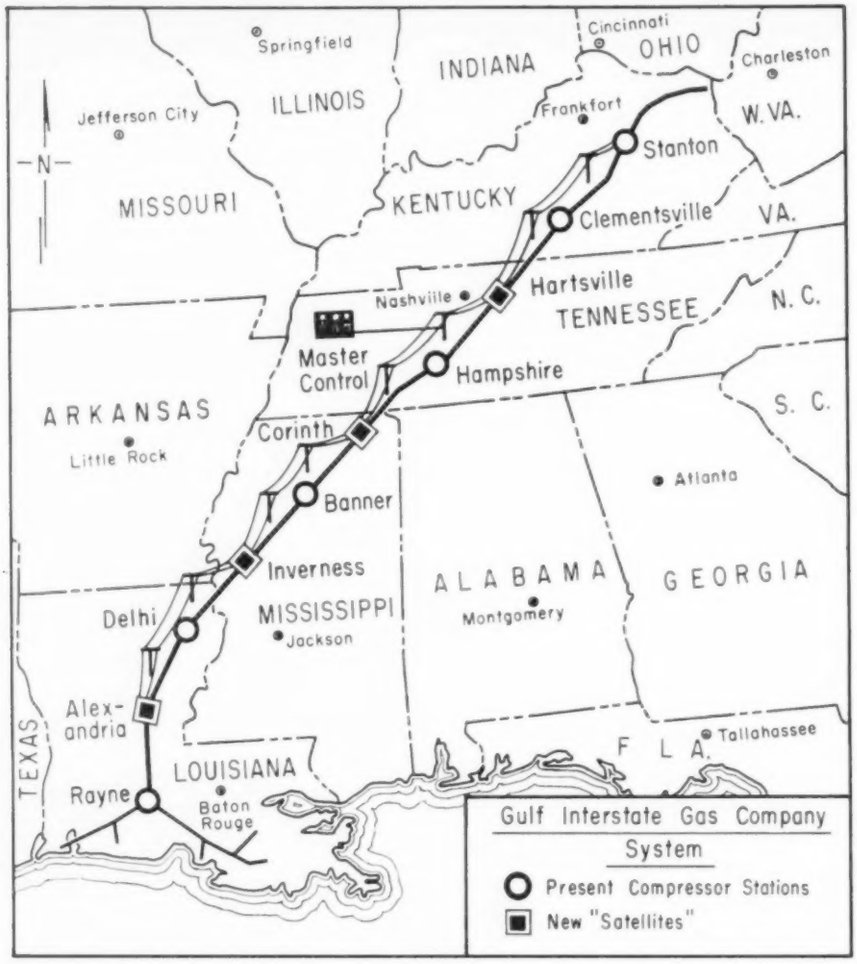
•

A Lot of Pipelining Goes a Long Way . . . Since 1946, U. S. pipe line growth has averaged 14,000 miles a year—at an average cost of about $16,000 per mile. If yearly pipe line averages were laid end to end they would be almost the same as laying five parallel pipe lines from New York to Los Angeles.

Ten year total would circle the globe *nearly six times.*

•

Trends in Crude Transportation . . . In '55, pipe lines once again made significant gains over other crude carriers. **Pipe lines** carried 398.9 million net tons of crude, 77.73 percent of the total—for a 1.36 percent increase over '54. **Water carriers** accounted for 15.81 percent, a 1.53 percent drop from '54. **Trucks** carried 5.75 percent, up .43 percent. **Railroads** carried .71 percent, down .26 percent.



Construction is now underway on Gulf Interstate Gas Company's four new engine-driven centrifugal compressor stations. All will be remotely controlled unattended "satellites." Operations will be directed from a master control point near the middle of the system.

Why Gulf Interstate Is Going to 'Satellites'

Unattended operation of the Stanton, Kentucky, station points the way to reduce costs with safety and dependability. Four new stations will follow the pattern.

By R. LoCHIANO
Gulf Interstate Gas Company
Houston

ALL OF THE reasons behind the selection of the equipment and design for Gulf Interstate Gas Company's "satellite" station at Stanton, Ky., add up to one thought. In the opinion of the designers and management, it affords the most economical and safe station for a particular type of operation.

This pioneer station went into main line service early this year and has been on completely unattended operation since June (See PIPE LINE INDUSTRY August, 1956, Page 37). It has a four-cycle, turbocharged engine driving a centrifugal compressor through a gear speed increaser. Station control is automatically performed by a controller which maintains a constant discharge pressure by varying the speed of the engine.

Operation is handled remotely from the master station at Clementsville, Ky., 90 miles away. The operator at the master station can change the set point on the discharge pressure controller and start and stop the engine at Stanton.

When the "satellite" station went on the line the particular combination of equipment was an innovation in gas transmission service. Equipment components were not new; all had been proven in years of operation but as a unit it was classed as "experimental" by the FPC. After a few months of successful operation, this tab was removed and it became the pattern for four future stations now under construction.

Each of the new stations will utilize the basic design of Stanton. New 3500 horsepower unit stations will be built at Rapides, La., Humphrey and Alcorn, Miss., and at Macon, Tenn. Another 3500-hp unit will be added at Stanton.

Economics Come First. Looking ahead to plans for future station construction, the Stanton design was a step forward over existing stations on the system. Economics of operation was the prime consideration. There are four components in the over-all economy of a compressor station — cost of installation, operation, fuel, and maintenance. To reduce the operating costs requires a reduction of manpower.

Existing stations were what is called "semi-automatic." They have only one operator to a shift. This required a completely automatic station without any operating personnel to cut costs further.

Taking the last operator off introduced many potential problems that had to be solved. A study was made on existing stations to determine what work the operator actually performed. The one item which took most of his time was the reciprocating compressors. They required periodic replace-

ent of broken valves and adjustments of compressor pockets. While both of these difficulties might be overcome to fit an automatic station, it was felt that the best approach would be to eliminate them if possible. This led to the selection of a centrifugal compressor.

The centrifugal compressor also had an economic advantage, because its lower maintenance cost and higher efficiency at low compression ratios made it appear a good choice over the reciprocating compressor.

If a centrifugal compressor was to be used, its prime mover had to be economical or it would nullify the advantages. Electric power was not available at a low enough rate to be considered, so only gas-fired engines were compared. Among these the turbocharged, four-cycle engine offered the best fuel economy by a fairly wide margin. The four-cycle engine also had the ability to operate efficiently at varying speeds which was desirable to provide flexibility in operating the station.

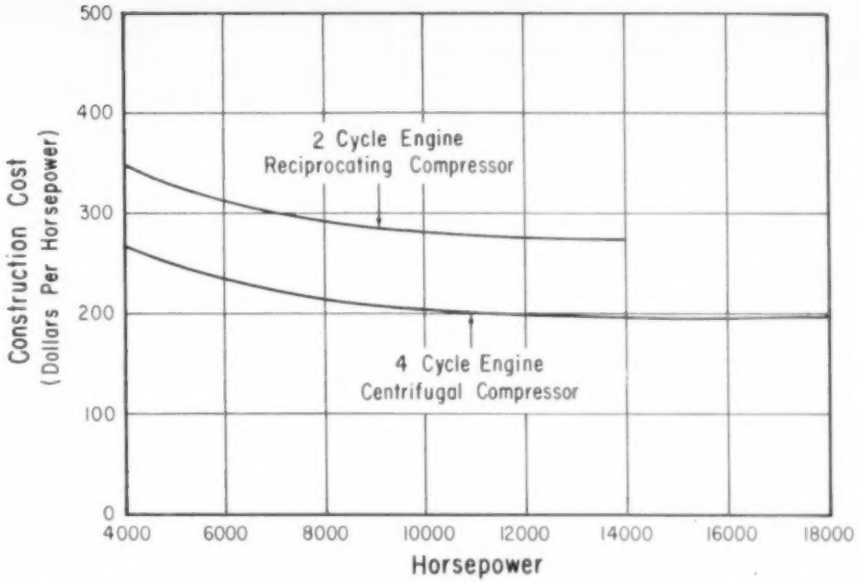


FIGURE 1—Comparison of construction costs points up one of the advantages of the four-cycle engine driven centrifugal installed at Stanton. Gulf Interstate's four new stations will have similar units.

Installation Costs Cut. Generally speaking the larger the horsepower of a unit, the cheaper it is to install on a per horsepower basis. This larger unit also was desirable to meet the requirements of the compressor whose size is determined more by the flow going through it than the horsepower required. For the large flows involved, the horsepower input could be quite large without increasing the size of the compressor. With these reasons as a basis, it was decided to build an automatic centrifugal-compressor station driven by a high-horsepower, turbo-charged four-cycle engine through a gear-speed increaser.

Comparison of costs and efficiencies between a two-cycle-engine-driven reciprocating compressor and a four-cycle-engine-driven centrifugal point up many advantages. Both types are installed on Gulf Interstate's main line. These engines are the latest design and offer the most efficient fuel consumption available today.

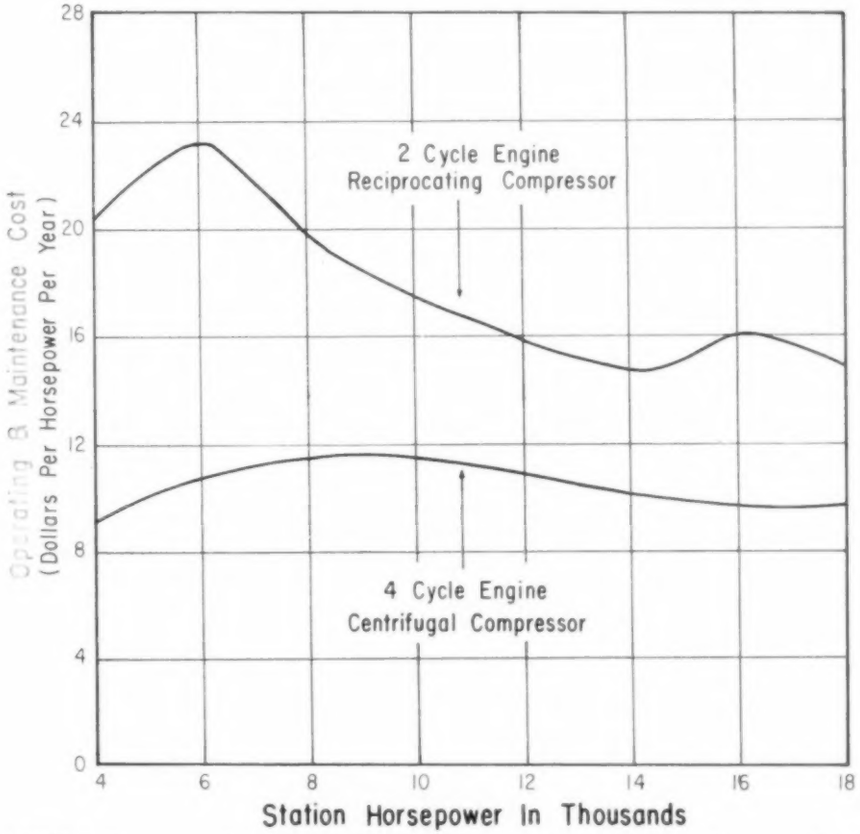


FIGURE 2—Lower operating and maintenance costs of the four-cycle engine driven centrifugal at Stanton were other important factors in the selection of these units for new satellite station operation.

Designs Must Be Compared. There are four points of comparison on which a new design has to be equal to or better than an existing one, before it can be justified. These points are (1) safety, (2) dependability, (3) accuracy of control and (4) simplicity and low cost.

Safety Is First. In the matter of safety, the intention was not to just make the station as safe as an attended one, but to make it safer. It had to be as safe as possible. This is one place that cost cannot be the guiding criterion.

To insure safety, every phase of the operation was studied to determine what could go wrong that would be dangerous. Then some method was worked out to provide protection by shutting down the engine, sounding alarms, turning on fire-fighting equip-

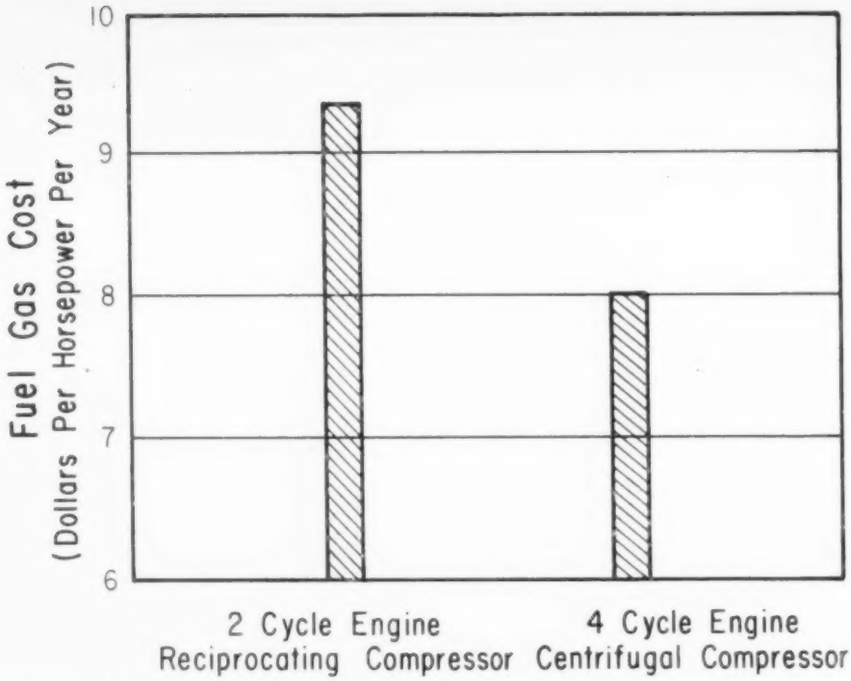


FIGURE 3—Fuel-gas costs are 15 percent less for the four-cycle engine driven compressor than for its two-cycle reciprocating counterpart. Still another reason for Gulf Interstate's design choice.

ment, opening blowdown valve, and so on.

To reduce the possibility of accidents or property loss, all equipment is "fail-safe." Loss of power or equipment breakdown will give the proper alarm or shutdown required.

Fire Protection. To reduce the possibility of fire, high pressure gas was not brought into the building, even in gage lines.

Three systems of fire detection are being used. One system "sees" the fire and is extremely sensitive but is subject to false alarms; a second is actuated by the rate of temperature change and is less sensitive but is not subject to false alarms. To complete the protection a third one is actuated by high temperature. It is the least sensitive but most reliable. The first system sounds an alarm which should bring investigating personnel.

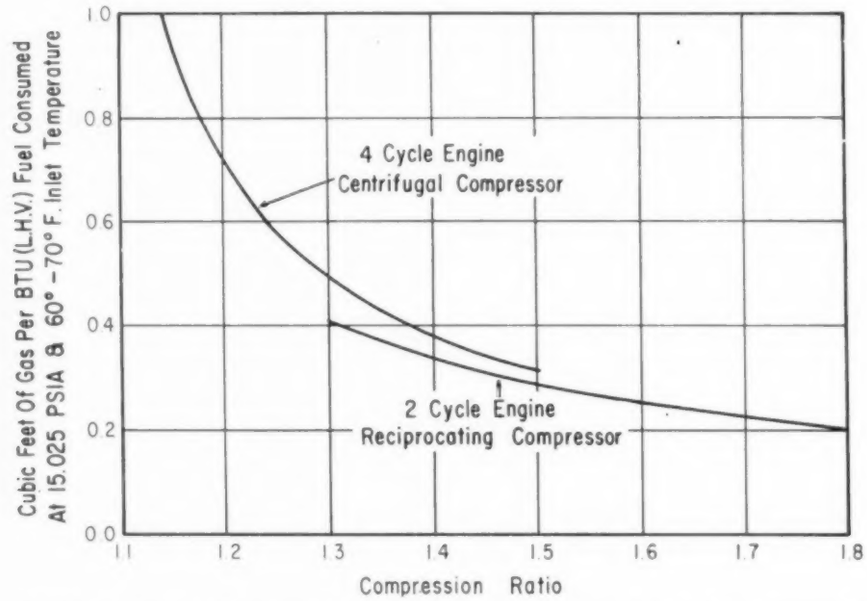


FIGURE 4—Stanton's design rates high in over-all station efficiency. Even at higher compression ratios where the reciprocating compressor is more efficient, the lower fuel needs of the four-cycle engine offset the advantage.

A pipe line operation office is headquartered at the station site and two company houses are located on the property, so that there is someone available to answer an alarm 24 hours a day. The second two systems back up the first one, and shut down the engine, close the station side valves, blow the yard gas piping down (which includes all fuel gas lines) and then after allowing time for the lines to be depressured, turns on a carbon-dioxide gas system which floods the area where the fire was detected in the building. The lines are depressured before turning on the carbon-dioxide system to take the force from behind the flames before hitting it with the extinguishing gas.

To anticipate the condition which might start a fire, a continuous gas sniffer samples the atmosphere from around potential danger areas.

As a safety feature the gas compressor is not only placed on the other side of the firewall from the engine, but is actually placed out of doors to minimize the possibility of a concentration of gas.

Sequence Check. Sequencing for the automatic starting of the engine and putting the compressor on the line is such that should any event fail to occur, sequencing will stop and have to be initiated again. Sensing devices for an action are on the results of the action and not the action itself. To explain, on the main-fuel gas valve, gas pressure is detected downstream of the valve to determine whether the valve opened. This system was preferred over having some limit switch on the valve itself.

Safety Devices Guard Station. Over-all, there are 52 safety devices used on the one-unit compressor station. These devices cover such functions as vibration of various pieces of equipment, gas surges, breaks in the pipe line, various operating pressures, temperatures, liquid levels, power failures, communication circuit failures, and others. With 52 functions being monitored continuously by control equipment, it should result in a much more thorough and safer job than an operator would do.

Service Important Too. Every gas company is vitally aware of its obligation of dependability of gas deliv-

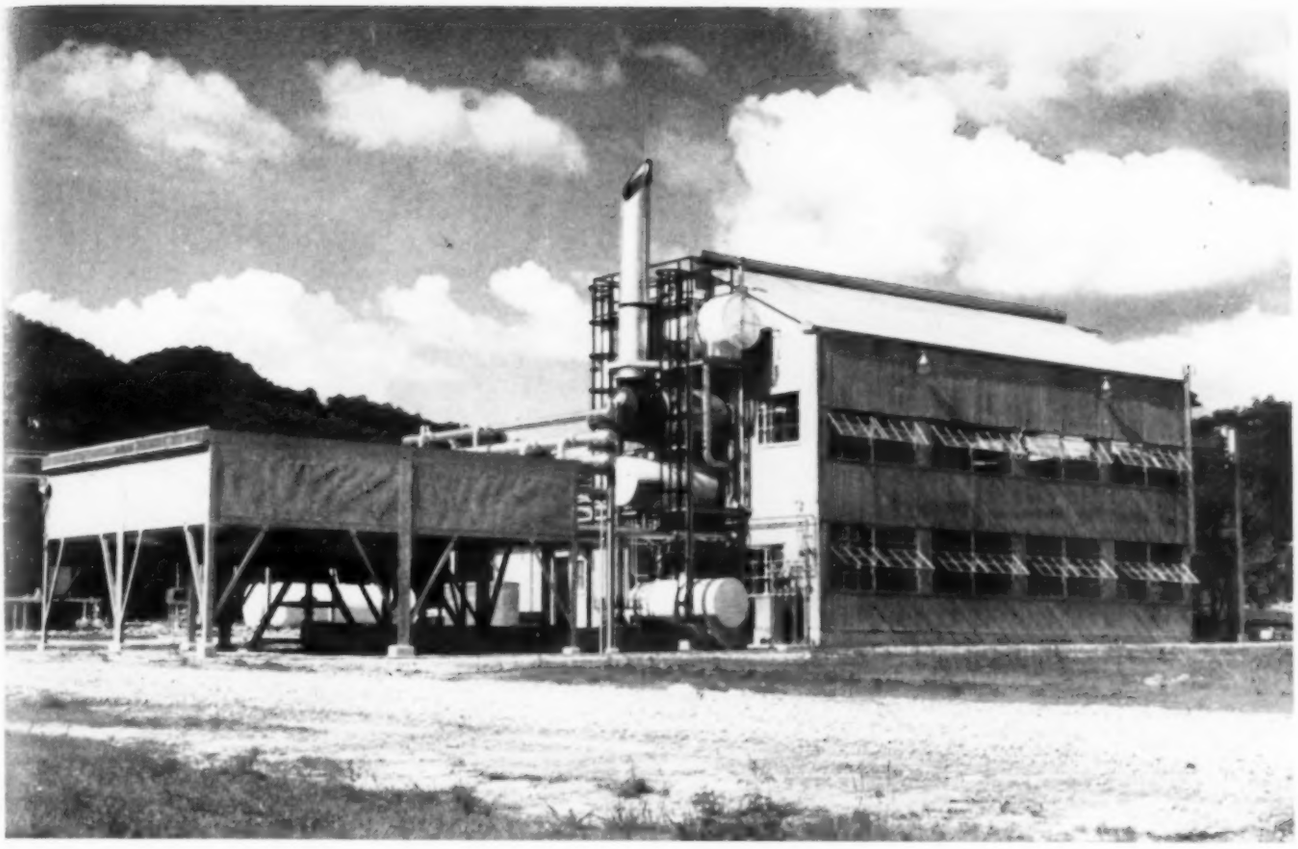


FIGURE 5—The first year of operation at Gulf Interstate's Stanton satellite station proved its safety and reliability. Four new stations will use similar design.

ery. Economy goes out the window if reliable service is lessened by taking the operator off the station. An engineer can design an automatic station as dependable as an attended one if he will watch all of the small details in his control system. Minor items seem to be the worst offenders at causing false shutdowns.

One of the least reliable features in connection with a remote controlled station can be the communication link that ties the master station to the satellite. A line may have periodic interruptions, which could be serious if the station's operation is dependent on its continuity. The best design is to have all controls at the station independent of the communication line as far as maintaining their last setting; the master station having only the ability to change the setting or condition. In other words, the satellite station is made "smart" and the master station "dumb." The satellite has the ability to do all of its own controlling and watching for troubles, while the master station has only the ability to change certain set conditions that are to be maintained, such as discharge pressure or engine start-up or engine shutdown.

Dependability of the station is only as good as the equipment used in the control system. Only the highest quality types of equipment made should be considered. No function of a control system can be underestimated when it comes to the selection of equipment.

Emergency Control Power. As loss of electric power would shut the engines down, because of the "fail-safe" system used on the control, it is of utmost importance to maintain a source of power. To do this, upon failure of the REA power a small generator unit automatically comes on to pick up the electric load. Should the emergency generator unit fail to come on the line, power for control is sustained by batteries.

To further promote dependability the engine is made self-sufficient. All of the auxiliary equipment for the normal running of the engine is driven by the engine itself. This includes the fan drive, jacket-water pump, engine lube-oil pump, lube-oil-cooling-water pump, seal-oil pump and gear-oil pump. All of the equipment is unitized so that one unit is

About the Author

R. LoCHIANO, Gulf Interstate's assistant chief engineer was responsible for the design and engineering of the Stanton, Ky., station. At present, he is directing design and construction of the four new unattended stations. LoChiano, a graduate mechanical engineer from Iowa State College, was formerly resident engineer with Panhandle Eastern Pipe Line Company and senior design engineer with Trunkline Gas Company. He is a registered professional engineer in Missouri and Texas.

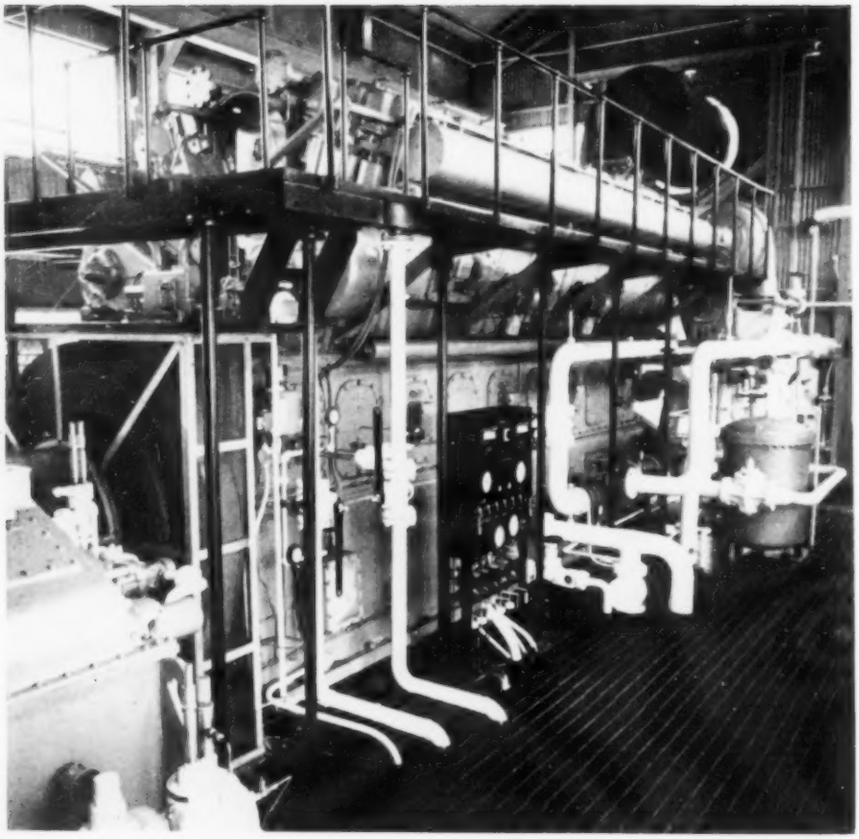


FIGURE 6—Stanton's power unit is a 16-cylinder 4-cycle LSV engine rated at 3500 horsepower. Fuel economies are about 6000 Btu per brake horsepower hour. The spark ignited engine is supercharged and utilizes turbocooling on manifold intake air to increase power rating with no increased heat load.

not dependent on another for any of its functions.

Accuracy Watched Closely. Accuracy is important in any control system to achieve reliable operations. On important controls such as the discharge-pressure controller, we used electronic instrumentation for maximum accuracy. As all instruments have an accuracy that is only a percent of their full scale, scales selected were evaluated carefully to determine the minimum range that could be tolerated.

To minimize distortion or accuracy, all telemetered quantities are put into a digital code as soon as possible. They are then transmitted and displayed in lights in that form at the "master" station.

Simplicity and Low Costs. Low cost in controls can be a serious stumbling block if not considered in the proper light. Savings should not be achieved by sacrificing quality but by eliminating unnecessary functions and keeping the system as simple as possible. To follow this rule, we telemeter to the master station only the information that would be usable to the operator at that end. For instance, we do not telemeter the position of loading valves, but merely that the compressor is on the line, which is not carried out until the valves are all in their proper position.

The 52 safety devices on the engine are grouped into three classifications—alarm, shutdown restart and shutdown lock out. These three pieces of information are the only ones that are telemetered.

Alarm items are ones that need attention but no damage can result from them in their present condition. Under this classification would be such items as oil level low and surge-tank level low. If no one attended to the low oil level, eventually it would all be gone, then low oil pressure would shut the engine down before it would be damaged.

The shutdown-restart group covers items that are serious enough to shut the engine down but not serious enough to preclude a restart to ascertain whether the condition has cleared itself. Most of the items in this group are high or low pressures or temperatures.

Shutdown-lockout functions are those that would be dangerous to try and restart the engine. A broken pipe line or vibration or equipment, which could indicate a broken part, fall into this category.

Sequence Telemetering. To keep the communication circuit costs at a minimum, information is brought into the "master" station sequentially; that is, all the information comes over the same line. To bring in an important bit of information without delay, all items are given orders of preference.

To make use of a single line, and yet to keep the operator informed of the current condition of the station, indicated quantities such as engine rpm and gas pressures are brought in only when a change beyond a prescribed magnitude occurs. With steady operating conditions, very few changes occur in an hour, yet the operator has the latest information that is of any significance to him.

Gulf Interstate's system makes use of a digital telemetered code for accuracy but this same type of code also allows use of the lowest cost telephone circuit—the 0-15 cycles per second system. This cost factor can become appreciable if the signal is sent very far as the rate is on a straight per mile basis.

To further keep costs low, all electric equipment and controls are placed outside of the hazardous area to get away from explosion-proof housing. This also affords a safer system by removing a potential source of ignition of the gas.

Stanton Record Good. Since March, 1956, there have been no false shutdowns that were not man-made. Some of the equipment has been changed because of lack of confidence in its sustained performance. The automatic station is definitely in Gulf Interstate's future. With that in mind, design of future stations for Gulf Interstate is being patterned after that at Stanton.

The Stanton station is only a forerunner of the stations in the future. Certainly, for instance, it is possible to have the controls decide when to start or stop engines to satisfy a desired flow condition. This and other features undoubtedly will be incorporated in stations of the future.

ACKNOWLEDGMENT

Based on a paper presented at the ASME Petroleum-Mechanical Engineering Conference, Dallas, Sept. 23-26, 1956.

Getting ready to start the problem. Here the properly wired panel boards are installed in the computer in preparation for running a calculation. In addition to pipe line engineering problems, operating and accounting departments make use of the machines to cut computing time.

Cut Calculating Time With Computers

Here is an effective way to reduce tedious routine work and free skilled men for creative thinking. Many pipe line engineering, accounting and operating problems may be programmed for quicker solutions.

By **GILBERT V. ROHLEDER**
Ohian Pipeline Company
Tulsa

Decisions made today can revitalize or strangle future pipe line operations. Realizing this, management now requires more and more data for the solutions to engineering, operating and accounting problems. Handling this volume of factual information is a growing problem. Electronic computers can save more than 50 percent of the calculating time in the first few solutions. More repetitive problems yield even greater savings.

Most of these problems revolve around fixed, long-term commitments involving data requiring many man-hours to collect, analyze and interpret. This often throws a heavy burden on effective use of manpower. Many of the most skilled employes are hampered with routine and tedious work. The result is a misdirection of energies and a smothering of ideas. Computers can eliminate much of the detail, releasing these skilled employes for more effective analysis and interpretation.

Electronic computation equipment makes solutions to pipe line problems more accurate, faster and economical. Computers are manufactured in many sizes, all of which are highly flexible. These machines process data in a variety of ways from routine accounting problems to complex scientific problems.

What Is An Electronic Computer?

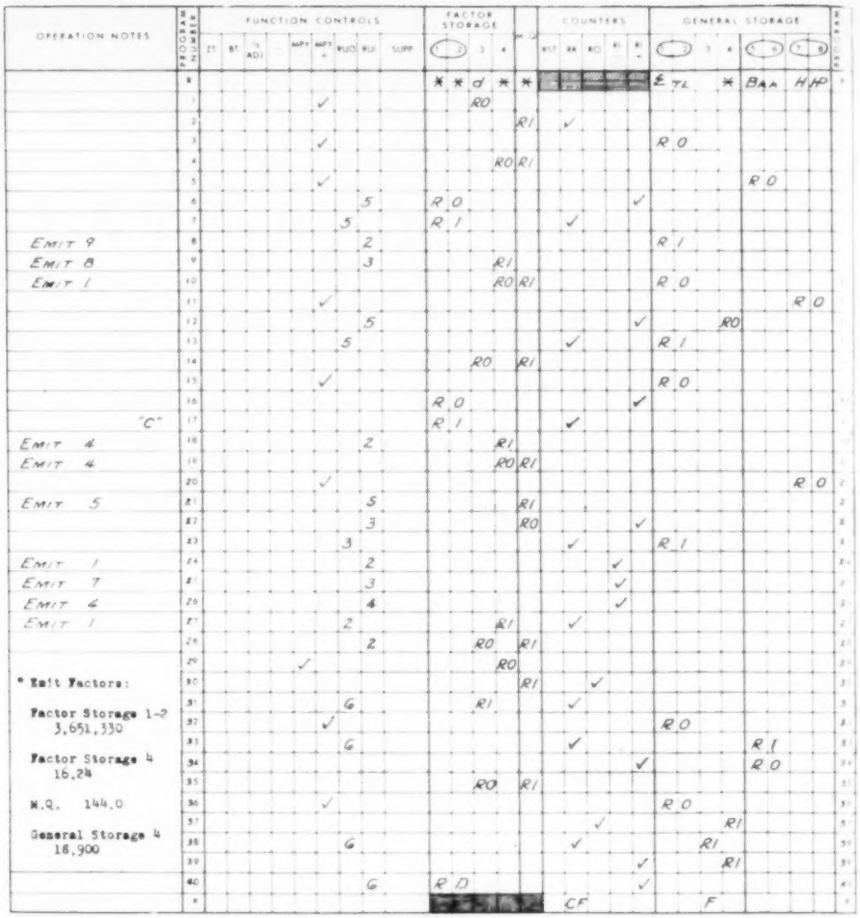
Basically, an electronic computer has five components:

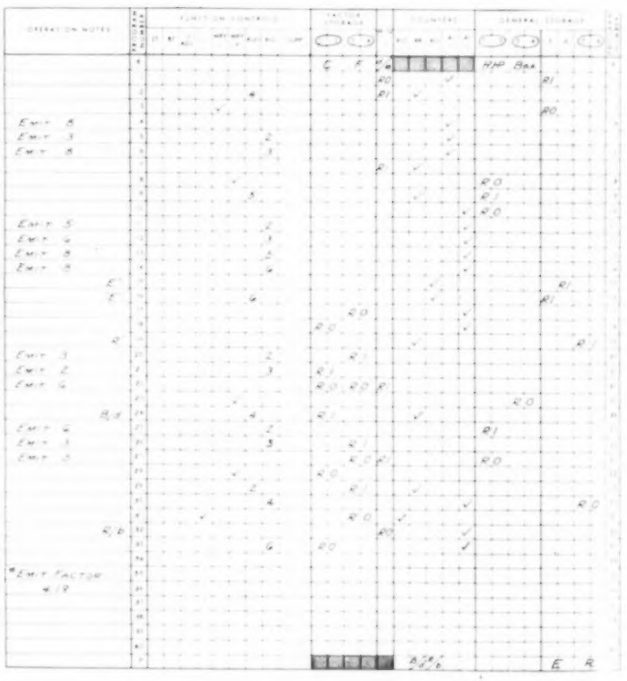
- Input
- Storage
- Arithmetic unit
- Control unit
- Output.

Information is read into the machine on either punch cards or tapes and put on a storage device to be used for later calculations. The arithmetic unit of the machine then draws on the storage device for information and performs the mathematical and logi-

About the Author

GILBERT V. ROHLEDER, a director and vice president of Okan Pipeline Company, entered the pipe line business as a junior engineer with Service Pipeline Company. He made numerous economic studies and later became supervisor of the Engineering Cost section. A registered professional engineer, Rohleder attended St. Joseph's College and Military Academy in Kansas. He served with the Second Infantry division during World War II and entered Massachusetts Institute of Technology in 1945, receiving his bachelor of science degree in mechanical and industrial engineering in 1948.





Above — A typical machine planning chart indicates how to wire an electronic computer to calculate fixed charges and power costs. Close cooperation is necessary between the pipe line engineer and the computer programmer to get best results.

Right—This machine planning chart gives instructions for programming a computer to calculate operating expense, revenue, barrels per day and revenue per barrel. Both accounting and engineering problems may be solved by merely changing the program for the computer.

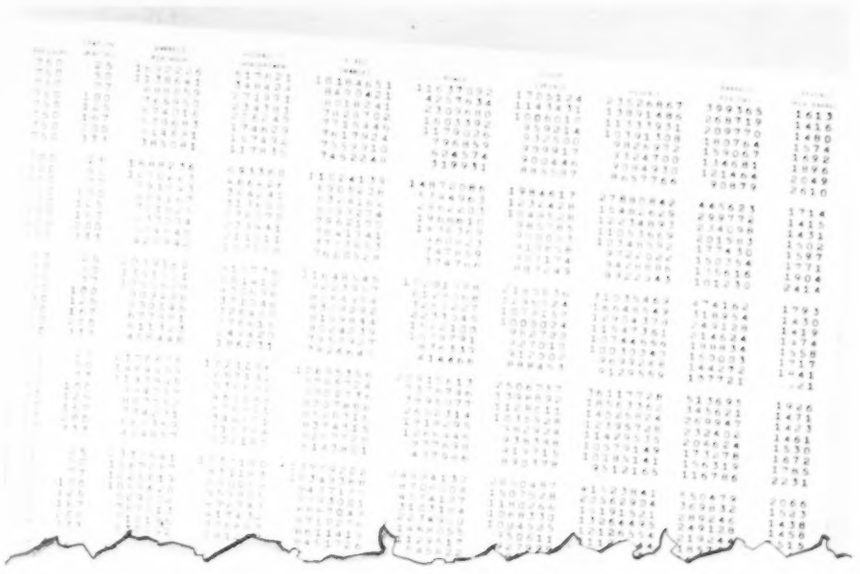
cal operations. The control unit links the various components together, causing the computer to function as a coordinated piece of equipment. Output of the machine can be printed, punched on cards, read onto tapes or stored in the machine for further use.

Where Can A Computer Be Applied To Best Advantage? A computer can usually be used to advantage by examining each manual data processing project requiring a large number of manhours. If a problem is to be solved only once, the time and expense of preparation for machine solution should be compared with that of manual solution. The problem need not be solved in its entirety by the machine in order to make feasible the use of a machine. The more tedious portion of the problem can be adapted to the electronic computer, releasing human energies for more creative thinking.

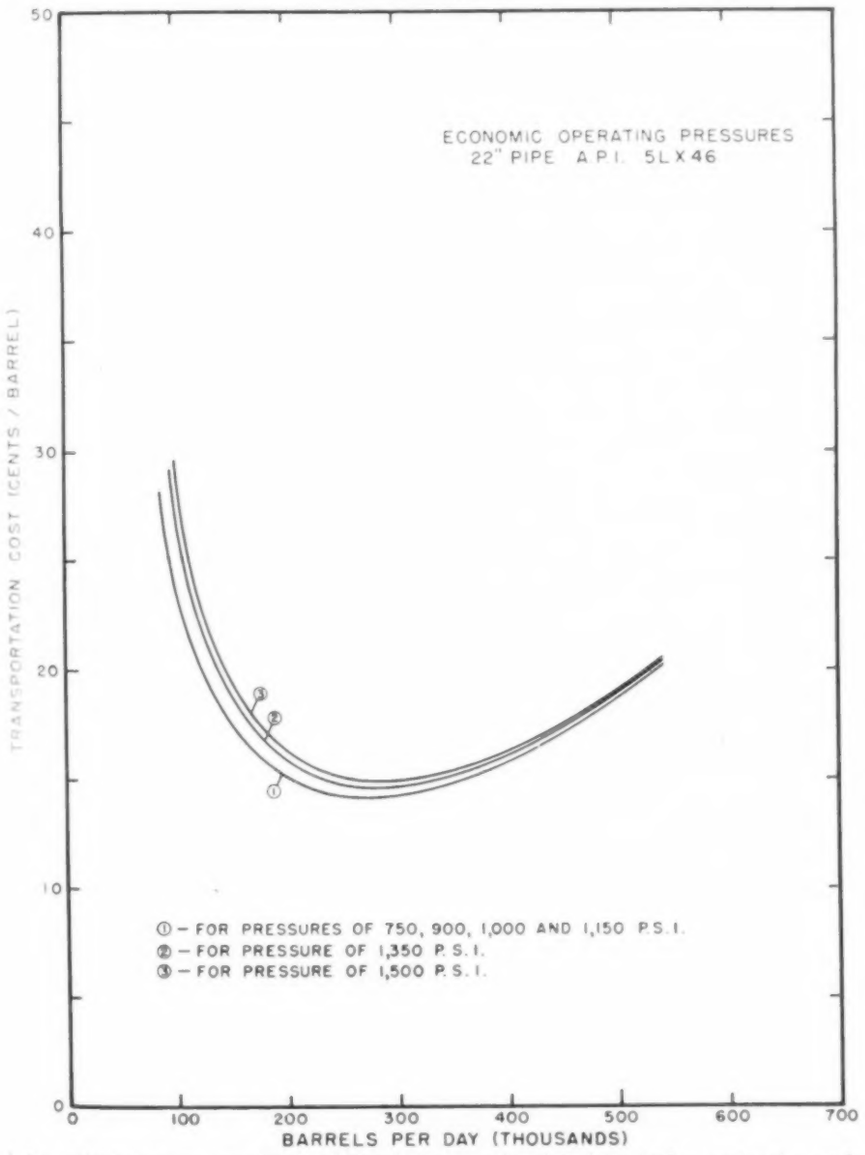
There are many considerations in determining whether a particular problem is a good machine application or if the machine installation is justified. Several factors favor machine computation:

• Electronic computing equipment can solve problems more effectively if there are a large number of calculations required or if the calculations are difficult and tedious.

• Machine computation can provide the economics of so many more means of approaching the same objective, thus presenting a better perspective for making decisions.



Results from the machine are summarized in this tabulated form and pointed out by the electronic computor.



When calculations are completed, tabulated data may be plotted for further engineering study. Accuracy and speed enable design engineers to carefully evaluate a greater amount of data before making a decision that may affect profits over many years.

Here's a Quick Yardstick for Pipe Line Computer Applications:

- **Study the information on the type, purpose, volume, frequency, time limitation, accuracy, procedures and overall costs of analyses now being performed without the use of electronic computers.**
- **Determine whether some of the present analyses can be eliminated or combined without hindering operations, or whether additional analyses can be made to improve them.**
- **Determine the cost and intangible advantages or disadvantages of machine computation over present method.**
- **Send key personnel to computer seminars to learn how to use the machine.**
- **For best economy and more effective use of the machine, pool the data processing needs of several departments such as Accounting, Engineering, and Operating.**

• Machine computations will give more accurate and quicker results, increasing savings by the use of many computations before expensive experimentation is undertaken.

Usually, it is preferable to begin with simple aspects of a problem rather than to tackle the more complex problems. As the simple problems are solved, the door is opened to methods needed to solve more difficult problems.

What a Computer Can Do. A computer can be programmed to perform any operation which can be accomplished manually with pencil and paper. If the method used in solving a problem can be written in concise and logical steps, the machine can be programmed to perform the solution. In fact, if one could notate the logical steps in the thinking process, the machine could be programmed to think! This is a very important point. A machine can do nothing it is not instructed to do. A computer can add, subtract, multiply, divide and make logical decisions. It is just as happy solving accounting problems as it is operating problems.

How Best To Use Computers. To solve a problem on an electronic computer, regardless of the location of the machine, someone must translate the problem into language the machine understands. Too often the person with the problem does not understand the machine while the person operating the machine does not understand the problem. This can cause misunderstanding and friction.

How can we overcome this situation? The best solution is for the person with the problem to learn enough about the machine to enable him to program his own problems. He should, at least, learn the capacity, limitations and basic characteristics of the computer in order to work intelligently with the machine operator.

Most manufacturers of electronic computers hold seminars and other instruction classes that can handily teach engineers, accountants and other company personnel the various operations of this equipment. In the case of a small company where the volume of work does not justify the purchase or rental of a computer, use can be made of computing centers established by the various manufacturers of this equipment.

Factural parts of many pipe line problems can be reduced to mathematical or logical steps and then placed in electronic computers. Here are some of the possibilities:

- **Economic studies of new systems**
- **Increased and decreased capacity operations**
- **Optimum operating pressures**
- **Overhead crossing designs**
- **Design of pipe casings and flanges**
- **Scheduling and dispatching**
- **Pipe line property mortality analysis**
- **Allowable pipe pressure tables**
- **Linefill tables**
- **Continuous interest tables**
- **Distribution of tariffs**
- **Apportionment of crudes**
- **Apportionment of overhead to operating expense**
- **Prorating expenses from clearing accounts**
- **Processing run tickets**
- **Tabulation of contractors' bids**
- **Retirement plan calculations**

Programming a Typical Pipe Line Problem

The Problem: To determine the most economical operating pressure for a 22-inch pipe line. This example shows what type of calculations the computer can accomplish, how it is programmed, and results of the solution. After the original planning chart has been prepared, the chart may be filed. On future calculations, the setup time will be reduced about one-third of the original.

Assume these conditions:

1. All estimates for investment and operating expenses are based on a 1000-mile line.
2. Investment required to build the line is borrowed for 25 years at 3 percent.
3. Equity capital will provide working funds after the line is built.
4. The desired rate of return is 7 percent.
5. Flow conditions are based on 37 degree API gravity and 60 SSU viscosity.
6. Pumping units are sized for maximum pressure and summer pumpings.
7. Pumping units are electric-centrifugal.
8. Tankage at initial station provides a three-day supply of crude oil.
9. Pipe is API 5LX46 with a C factor of zero.

Basic Data for 22-Inch—API 5LX46 Pipe

Outside Diameter Inch	Wall Thickness Inch	Inside Diameter Inch	Allowable Pressure psi	Equivalent Length Factor
22	.250	21.500	661 P_9	.973 F_9
22	.281	21.438	750 P_8	.980 F_8
22	.312	21.376	831 P_7	.986 F_7
22	.344	21.312	916 P_6	.993 F_6
22	.375	21.250	1000 P_5	1.000 F_5
22	.438	21.124	1170 P_4	1.026 F_4
22	.469	21.062	1252 P_3	1.043 F_3
22	.500	21.000	1336 P_2	1.060 F_2
22	.563	20.864	1509 P_1	1.088 F_1

1. Allowable Pressure $(P) = \dfrac{2\ St}{D - t}$

   where: S = stress in psi = 72 percent of the yield point
   t = wall thickness in inches = .875 of the average thickness
   D = outside diameter in inches

2. Equivalent length factor $(F) = \left(\dfrac{D_{.375}}{D_x}\right)^{4.118}$ This factor converts pressure drop or length to 21.625 ID pipe.

   where: $D_{.375}$ = inside diameter in inches of 0.375 wall thickness pipe
   D_x = inside diameter in inches of pipe with wall thickness other than 0.375

3. P_0 = station suction pressure

ANALYZING PRESSURE AND FLOW CONDITIONS:

1. Assume a station spacing and maximum operating pressure.
2. Calculate pressure drop per mile

$$P_{1m} = \frac{\dfrac{P_1 - P_2}{F_1} + \dfrac{P_2 - P_3}{F_2} + \cdots\cdots\cdots + \dfrac{P_9 - P_0}{F_9}}{L_T}$$

   where: L_T = station spacing in miles

3. Substitute (2) into: $B = \dfrac{\left(0.750\ D_i^{2.716}\right)\ \left(P_{1m}^{0.572}\right)}{\left(v^{0.141}\right)\ \left(s^{0.572}\right)}$

   where: B = barrels per hour
   D_i = inside diameter in inches
   v = viscosity in centistokes
   s = specific gravity

4. Calculate hydraulic horsepower required
   HHP = .000408 B P
   where: HHP = hydraulic horsepower
   P = maximum operating pressure

5. Calculate miles of pipe required for each wall thickness
   $L_1 = \dfrac{P_1 - P_2}{P_{1m} F_1}$ $L_2 = \dfrac{P_2 - P_3}{P_{1m} F_2}$ etc.

ANALYZING INVESTMENT COSTS:

1. Line investment costs (C_L)
   $C_L = 28.23\ D\ \$/\text{ton}\ d(t_1 L_1 + t_2 L_2 + \ldots . t_9 L_9) + 5280\ L_T d Z$
   where: Z = company and contract cost per foot
   D = outside diameter—inches
   d = number of stations
   t = wall thickness—inches

2. Station investment costs (C_S)
   $C_S = 131000\ d + 58 c d HHP$
   where: c = capacity factor which converts annual average barrels to summer barrels

3. Tank investment costs (C_T)
   $C_T = 112.1\ B$

4. Communications investment costs (C_C)
   $C_C = 1400\ L_T d$

5. Miscellaneous buildings, tools and equipment carried at a constant amount of $300,000 for a 1000 mile line.

6. Sum all investments costs to obtain total investment (C).
   $C = C_L + C_S + C_T + C_C + M$

ANALYZING YEARLY OPERATING EXPENSE:

1. Power costs per year (F).
   $F = 50{,}000\ d + 44\ d\ HHP$

2. Other operating costs (E), including direct labor, materials, expense accounts, operating supplies, fringe benefits and overhead.
   $E = 841{,}000 + HHP\ (4d - 8)$

3. Add F to E

ANALYZING GROSS REVENUES REQUIRED TO EARN 7 PERCENT

1. Gross revenue (R) after considering 50 percent income tax, 3 percent interest on borrowed money, 40 percent depreciation, 1 percent ad valorem tax, and 4.5 percent transportation tax.
   $R = .1449\ C + 1.0471\ (F + E)$

2. Gross revenue per barrel (R_B).
   $R_B = \dfrac{8614\ B}{R}$

3. Print pressure, station spacing, barrels per hour, hydraulic horsepower, fixed charges, power costs, other operating costs, revenue per year, barrels per day and revenue per barrel.

4. Plot graph of revenue per barrel, versus barrels per day versus operating pressure.

—The End

FIGURE 1—Harold Thomas, El Paso Natural engineer, breaks problem into its simplest steps, and codes it into "language" of the computer. Programming is most tedious and time-consuming part of preparing a problem.

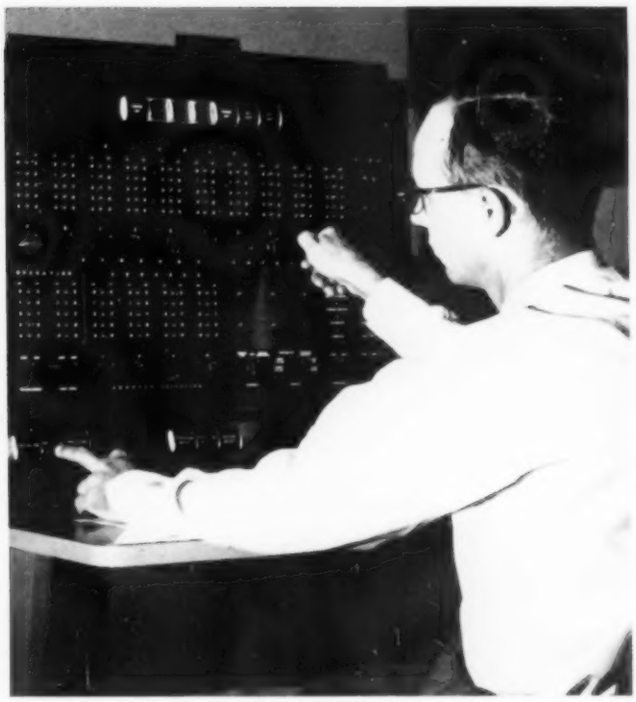


FIGURE 2—Bill Healy checks operation of machine. Flashing lights of console provide minute-to-minute record of operations, and can also be used to feed additional spot information into computer.

Computer Aids in Gas Pipe Line Design

In its first 12 months of operation, El Paso Natural's electronic computer has saved countless man-hours in solving major pipe line design problems.

By **HAROLD E. THOMAS**
El Paso Natural Gas Company
El Paso, Texas

ELECTRONIC COMPUTERS are the answer to a pipeliner's dream.

If anyone doubts this statement, just ask one of the El Paso Natural Gas engineers who have used the company's year-old computer. They will tell you how they can now observe the flow conditions of a cross-country pipe line—how they can "watch" the operation of a compressor station hundreds of miles form El Paso's home office.

They will tell you how they can literally "blow up" a pipe line with tremendous overloads if they wish, to see what happens. The result gives the company's engineers the equivalent of many years of solid experience without putting a joint of pipe into the ground.

Put into practical business terms, electronic computers are helping El Paso build the best pipe lines for the least money. There are other "plus" factors, too, which have to do with creativeness in engineering design, and the chance to try something new.

About the Author

HAROLD E. THOMAS joined the Engineering Department of El Paso Natural Gas Company in July, 1953. He worked in the Company's first application of a computer to engineering problems—and is now Engineer representing the Engineering Department to the computer facility, which is a centralized section for all computer applications in the Company. Thomas graduated from Eastern New Mexico University in 1951 where he majored in mathematics.

How Computer Is Used. El Paso Natural's electronic data processing machine has the ability to perform arithmetic and logic operations at tremendous speeds. However, its present high efficiency is the result of considerable advance planning.

Before installation, El Paso told the manufacturer what type problems it wanted the computer to solve. The machine was delivered with a set of interchangeable panels which equipped it to solve those problems.

However, before the computer can perform with any of its control panels, its whole operation must be programmed. This requires the breaking down of a formula or problem into its simplest arithmetic and logical steps by the engineers. Programming is the most tedious and time consuming part of the procedure—a shoo-in candidate for the disadvantage column when the efficiency of the calcu-

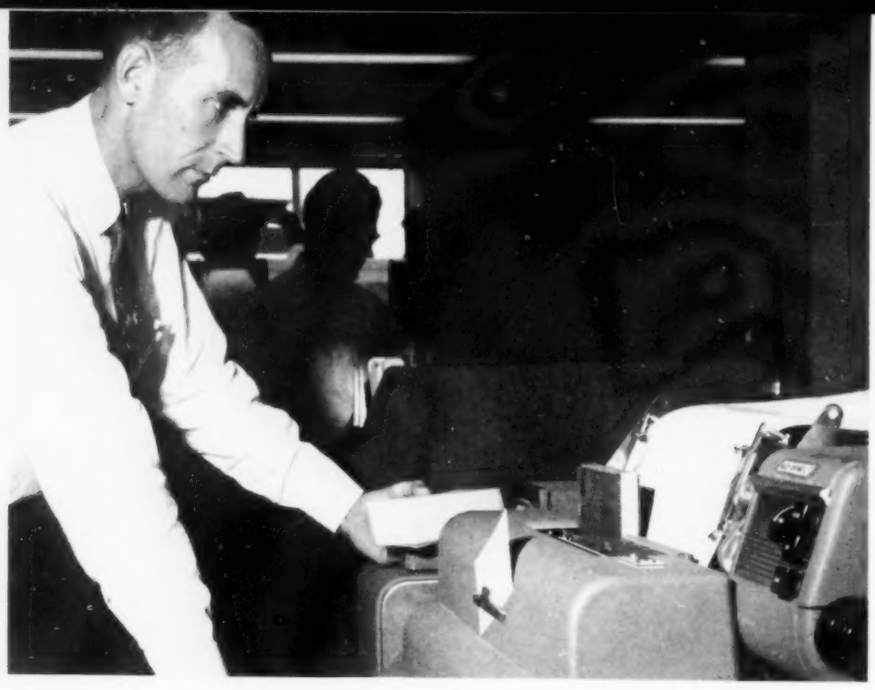


FIGURE 3—After computer has solved problem and punched results in a set of cards, these are fed into a tabulation unit for printed result which can be read and studied by company engineers. Here Les Porter checks results of problem as it comes out of tabulator in printed form.

lator is weighed pro and con.

Arrayed against the one disadvantages are these advantages:

- Computer is not subject to such human factors as emotion, fatigue, illness, or the Wednesday afternoon nine holes.
- Day in and day out, the machine performs with faultless accuracy.
- With such a tirelessly efficient worker around, engineers are freed to investigate the finer points of each problem, to obtain optimum answers to it, perhaps developing several alternate solutions.

Another factor which minimizes the disadvantage of time spent in programming: The programs can be used over and over again.

For example, it took two men almost six months to program a complete pipe line project for El Paso's computer. Their equations reduced the entire operation to simple step-by-step terms. Data were then transferred to cards and coded into the "language" of the computer. These were fed into the machine, which calculated its answers to the questions, and printed them on another set of cards. The answer cards were then run through a tabulating machine which printed the answers numerically on paper.

Result: A complete picture of how the proposed pipe line, its compression facilities and other components would perform.

With the same basic programming, variants can be fed into the calculator in an almost endless variety, probing for the best possible solution to the particular pipe line design project. Compression horsepower can be decreased, loop line mileage increased, or vice versa. Gas volume can be stepped up, reflecting an expected periodic increase in demand. Anticipated expansion of facilities can be added in and tested.

Also, theoretical emergency situations can be set up to test the ability of a particular design. One example could be the complete shut down of a compressor station. Such advance analysis of a pipe line before it goes into the ground is of immense importance. Problems like these are handled in a matter of minutes by the computer.

Saves Time and Manpower. What makes the original six months of programming for pipe line calculations take on added value is the fact that with this program, all that is needed to figure on any pipe line are profile mileposts and evaluations. This means that the computer, given the new "picture," can turn out a complete evaluation of a pipe line in less than 30 minutes, including the time necessary to set it up.

The same job would take a man more than three weeks, and there would always be the possibility of human error somewhere in the maze of resulting figures, nullifying the whole effort.

Since there is the involvement of so much time in the programming procedure, one of the requirements of problems used is that they be repetitious in nature. The parameters of the problem may change, but the procedure must stay the same.

An application may, too, be programmed with varying degrees of efficiency, more time being required for the best results. Problems are studied from this angle—just how much information is needed—and how frequently they are to be performed—to determine the amount of programming time to be expended on them if at all.

Magnetic Drum is Computer's Memory. The type of computer which El Paso Natural has in operation differs from other electronic computers primarily in its storage facility. The storage or memory unit is a magnetic drum. This drum is a cylinder with a sheet of magnetic material wrapped around its surface.

As the drum revolves, bits of information in the form of current pulses may be stored on its surface as magnetic spots. Information to be stored is a ten-digit number with associated sign, referred to in computer terminology as a "word." This word may be either data information or an instruction operation code, which the machine has been designed to interpret as some arithmetic or logic operation. Each word may be replaced by new information at any time. It is retained on the drum until a new word is recorded in its place.

Computers designed by different manufacturers have varying capacities as to the number of words which may be recorded on the drum. The general capacity range is between 1000 and 2500 words. This type of computer is internally programmed; that is, the program of instructions which the machine is expected to follow is kept on the drum. The machine automatically reads one instruction from the drum, executes it, reads the next instruction, and so on.

The basic arithmetic operations such as addition, subtraction, multiplication, and division and simple logic operations are built into the machine. Using these basic operations as building blocks, elementary transcendental functions needed in engineering calculations, such as logarithm, antilogarithm, and square root are pro-

rammed. These sub-routines give ore flexibility to the programming engineering applications.

Computer Has Helped El Paso Solve Three Major Problems. Since e fall of 1955, when El Paso Natral placed its machine in operation, here have been three major engineerg problems set up as applications:

1. Pipe Line Design Problems

Utilizing the computer to assume e burden of much of the tedious anual calculation gave pipe line design engineers more time to study the problem from an engineering standpoint. As much control as possible was programmed into the machine in order for it to be able to make simple decisions to keep the design within limits specified by the engineers. Four different types of calculations were needed, and are basic to the programming of any similar problem:

- **Pipe line flow calculation** computes the pressure loss due to friction between points along the pipe line and also adjusts this pressure with static head conditions affected by the differential elevation between the two points. A modified Panhandle Eastern flow equation is used for this calculation.
- **Loop line calculation** uses the same modified Panhandle Eastern flow equation but varies the parameters. The purpose of the routine is to compute the number of miles of pipe line, of specified size, paralleling the existing system, necessary to meet certain pressure conditions. These pressure conditions may have been computed on a previous calculation pass or may have been specified at the beginning of the problem.
- **Empirical polynomials** have been derived for the horsepower versus compression ratio curves for a reciprocating compressor engine. Using these polynomials and a computed or specified compression ratio, this routine computes horsepower requirements at a reciprocating compressor station. The fuel used is computed and added to the discharge flowing volume to give flowing volume on the suction side of the station.
- **Centrifugal horsepower formula** was programmed in the same manner to obtain the horsepower and fuel requirements at a centrifugal compressor station.

Control routines are programmed to integrate the usage of these calculation routines. These routines also control the input of pipe line data from punched cards and the output of results into punched cards.

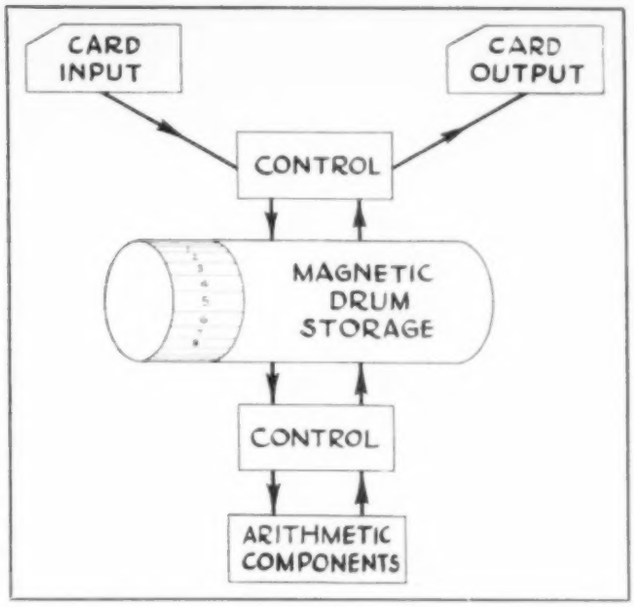


FIGURE 4—Diagram illustrates operation of El Paso computer's data storage facility—the magnetic drum. This is a cylinder with sheet of magnetic material wrapped around its surface. As drum revolves, bits of information in the form of current pulses are recorded as magnetic spots in surface of the drum. Information is inserted or taken out on cards indicated above.

Drum Storage Capacity. Programming of the transcendental functions sub-routines, the four pipe line and horsepower calculations, and the control routines required 1300 words of drum storage capacity.

This left 700 words available for pipe line data to load the 2000-word drum to capacity. These 700 words were divided into 70 ten-word blocks. Each point on the pipe line where a pressure computation is required, such as a take-off volume point or elevation correction point, uses one of these blocks.

The data which must be supplied for each point are: milepost, elevation, pipe data, allowable working pressure of pipe, and tap volume. In addition, two words must be left open for the computed pressure and volume of gas flowing through that particular line section.

Each compressor station, whether reciprocating or centrifugal, required two of these 10-word blocks of data. Data which must be specified are: milepost, elevation, discharge pressure limit, installed sea level horsepower, pipe data, horsepower elevation correction, and compression ratio. Data which must be computed to fill in the blocks, are: brake horsepower, discharge pressure, volume compressed, sea level horsepower required, suction pressure, and fuel. One block is used for the input of initial flow conditions (pipe line efficiency, specific gravity, flowing temperature, and pressure base). Each time any one of these factors changes along the pipe line, a new block is required.

Use of Instruction Cards. With the drum filled to capacity, the only means of exercising any further control is by an instruction card. These cards are read by the machine each time the computation, proceeding counterflow, reaches the discharge of the compressor station successfully within specified limits.

The instruction card is effective for the compressor station just reached and the pipe line section upstream to the discharge of the next station. It is used to:

- Specify what procedure to follow to keep the system within the desired limits.
- If the sea level horsepower limit has been exceeded, the instruction card tells if additional horsepower is desired to maintain the specified ratio or if a new ratio should be determined using the horsepower limit.
- The station computation can then be completed.

The pipe line flow calculation then computes pressure along the pipe line to the discharge of the upstream station. When the point on the discharge of the upstream station has been computed, the machine checks to see if the allowable working pressure of the pipe or the discharge limit pressure has been exceeded. If either of these conditions has been exceeded, the instruction card is again consulted to see if loop line has been requested or

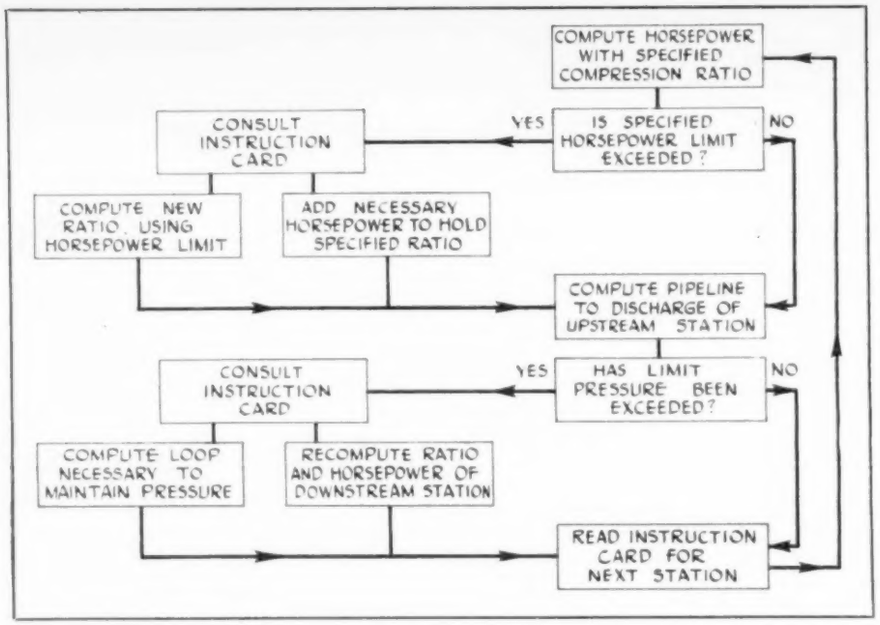

COMPUTE HORSEPOWER WITH SPECIFIED COMPRESSION RATIO
IS SPECIFIED HORSEPOWER LIMIT EXCEEDED?
YES
NO
CONSULT INSTRUCTION CARD
COMPUTE NEW RATIO USING HORSEPOWER LIMIT
ADD NECESSARY HORSEPOWER TO HOLD SPECIFIED RATIO
COMPUTE PIPELINE TO DISCHARGE OF UPSTREAM STATION
HAS LIMIT PRESSURE BEEN EXCEEDED?
YES
NO
CONSULT INSTRUCTION CARD
COMPUTE LOOP NECESSARY TO MAINTAIN PRESSURE
RECOMPUTE RATIO AND HORSEPOWER OF DOWNSTREAM STATION
READ INSTRUCTION CARD FOR NEXT STATION

FIGURE 5—This is an example of control routines used to integrate usage of calculation routines and to check computations at various points to determine if system is still within specified limits. If limit is exceeded, machine will either consult an instruction card to determine manner in which to proceed or will proceed as specified in the program.

whether a new suction pressure should be computed at the downstream station and horsepower added.

How to Run a Complete Pipe Line Study. To run a complete pipe line study, the first step is to load the 1300 words of programmed calculation instructions. The second step is to load all pipe line data into the remaining portion of the drum. Pipe line data cards are followed by a card specifying starting pressure and volume conditions. Instruction cards prepared by the engineer are then placed in the input card feed to be consulted as computation processes up the pipe line.

At the conclusion of the calculation, all data, complete with pressures, volumes, required horsepower, fuel and other necessary items are stored on the drum. When the complete system is balanced within specified limits, the machine punches answers into cards. These punched cars are then run through a tabulating machine which prints results in the form required by design engineer.

A typical main line study requires about ten minutes computing time. It is estimated that this same study done manually would require 2 to 3 weeks of computing time for one man.

2. Process Equilibrium Calculations

Another engineering application frequently used is the process equilibrium calculation. The purpose of this calculation is to determine the ratio of liquid to vapor in a fractional distillation process.

The input feed into the plant and equilibrium constants for each particular component of the feed mixture, at certain temperature and pressure conditions, must be specified. The calculation programming uses an iterative scheme that corrects the ratio each trial until convergence is obtained. The input data must contain the quantitative breakdown of the feed mixture and the equilibrium constant for each component.

Plants with several different stages, with different pressure and temperature conditions, may be run, and the process is re-cycled until a complete balance is made.

A typical flash calculation of three stages would probably take 15 minutes to compute. The final results are printed in a form that contains the quantitative feed breakdown, given equilibrium constants, quantitative breakdown of both the liquid and vapor outputs of the plant, liquid to vapor ratio, and specific gravity and Btu content of the mixtures.

3. Processing Mass Spectrometer Data

The purpose of this application is to determine the quantitative chemical analysis of mixtures of gases. The samples to be processed are known to be made up of certain compounds. The problem is to determine the proportion of each compound in the mixture.

A known mixture is fed through the mass spectrometer for calibration. The calibration then comes in the form of 12 simultaneous linear equations. With these equations forming the calibration matrix, unknown samples of gas may then be processed through the mass spectrometer and the quantitative analysis of the unknown mixture then can be made. The computer has been programmed to process the data obtained from the mass spectrometer and compute the amount of each component in the sample.

The results from the processing of this data contain the component breakdown and the Btu, specific gravity and vapor pressure of the mixture. The calibration matrix requires approximately ten minutes to process through the computer. When this is done, each separate mixture can be computed in approximately one minute.

The application of the computer to measurement calculations has facilitated that problem considerably. After the meter charts are integrated, the computer is required to calculate the volume recorded and correct it for specific gravity, temperature, Fpv, and contract pressure base. Meter charts from all gas sales, purchases, and fuel meters are processed in this manner. Daily, weekly and monthly reports are tabulated from these calculations. Approximately 35,000 charts per month are processed. Computing time required for this application averages about 1½ hours per day.

Other Computer Applications. Other computer applications which are being considered and set up are proration well deliverability calculations, compressor capacity calculations and process absorber calculations.

Engineering problems aren't the only ones fed to El Paso Natural's computer. The company's Accounting department, for instance, frequently requests the services of the machine in the computing of taxes.

Other uses are sure to make their appearance as the industry steadily moves toward more and more automatically conceived and controlled processes in its operative procedures.

—The End

Are Pipeliners Ready for Automation?

Not completely—much is yet to be done in the field of automation training. Here are some excellent ideas designed to help you set up your training program.

By **RICHARD W. DONNELLY**
The University of Texas, Division of Extension
Austin

GROWTH OF AUTOMATION in the pipe line industry depends directly on the ability of semi-skilled workers to adapt to the change from one method of operation to another—and the ability and availability of qualified instructors to train.

Past experience in the training of operators and other semi-skilled workers in the petroleum industry indicates little doubt of their ability to adapt or their willingness and desire to learn. Given some understanding of the *why*, most of these men are eager to know the *how*. The best students in classes on controls and measurement for production and pipe line operations have been in this group. Their attentiveness and attendance in classes are the best of any group.

With a need for training and a willing learner, all that remains to complete the change is to supply the training.

Who should do the training, company personnel or outside organizations? This is a question which has come up many times and probably will be discussed every time a training program is considered. Experience and observation prove that neither companies nor schools alone will be able to fill the needs of the near future.

There is not only a shortage of engineers and skilled workers, there is an even more acute shortage of training personnel. Of the dozen or more oil and gas pipe line companies that have adopted automation training programs in the past few years, not one had a training department or technical men with training experience capable of handling the immediate training needs. Nor has any single state university or other training agency the trained personnel with enough technical experience to do an adequate job. Where, then, do we go?

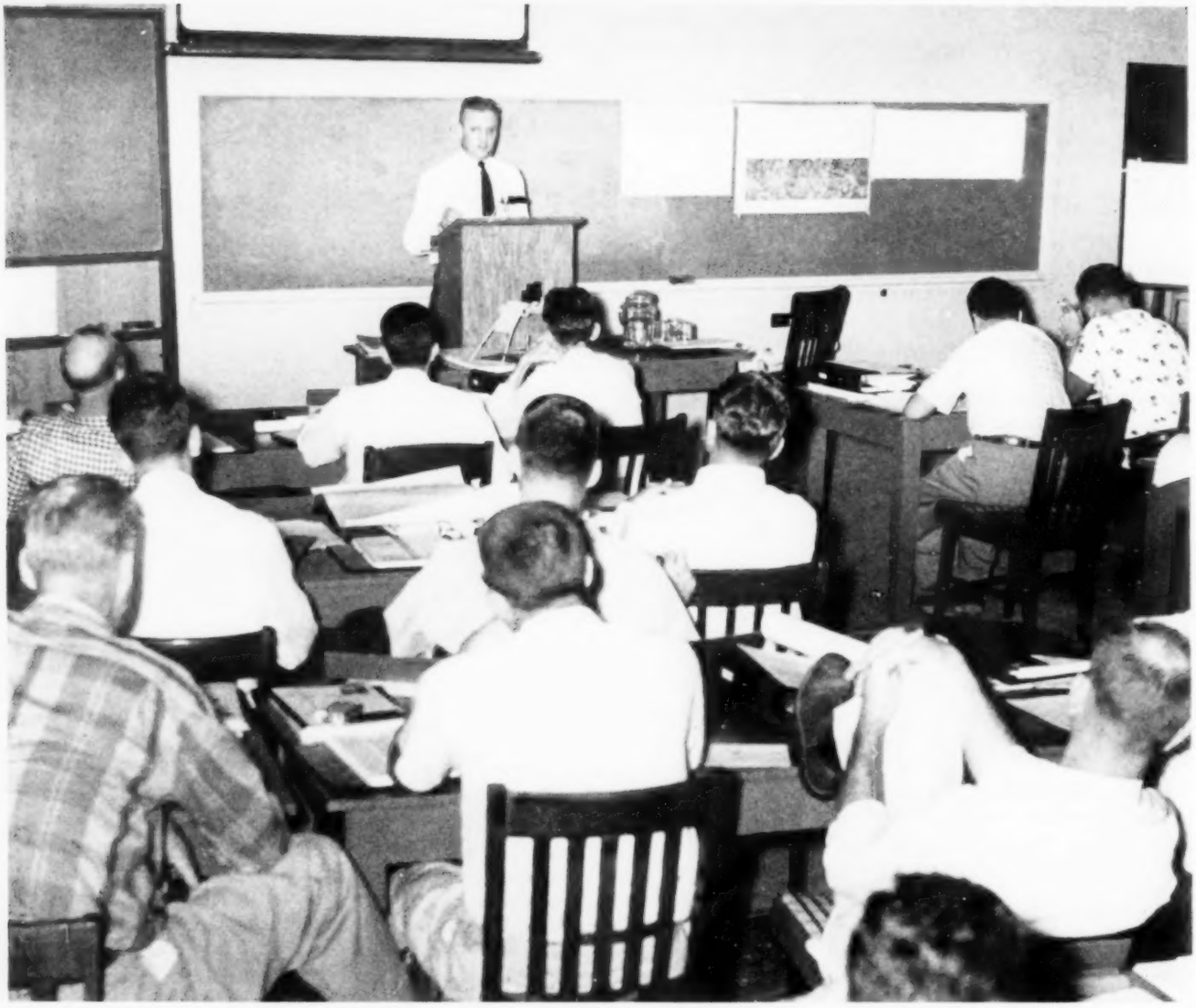
Answer: Closer Cooperation. The only possible solution at the present time is cooperative efforts between company technical and training personnel and outside agencies. Company men supply necessary technical knowledge, and training men the experience in preparation and presentation of training itself. This method has worked with excellent results on several occasions.

Setting Up the Program. As an example of how this works, let's suppose that a pipe line company has an anticipated program for modernization and automation. Its personnel are trained only in the operation of less complex equipment. To fit them into the changing operations, management decides to start a training program for the upgrading of operators and other

Training Is a Must

Training is essential for the efficient use of new automation devices and procedures in existing or new pipe line systems. It provides the stepping stone from operator to technician, and the understanding necessary for automation to be accepted by the employe.

In addition, it results in better personnel relations by giving the employe an opportunity for self-improvement, a common ground of understanding with his fellow workers, and an appreciation of the other man's job.



James Ball, Magnolia Pipe Line Company, Dallas, instructs class at the API School of Pipe Line Technology, Baytown, Texas. Such classes are doing much to prepare pipeliners for the changes in operations brought about by automation.

semi-skilled workers.

The problem is given to the company training man who contacts the training service for assistance. Conferences are held between training service personnel and company management personnel to formulate a plan for development and presentation. General objectives of the program are decided—is it to provide an over-all understanding of operations and fundamentals for all employes or is it to provide a skill for selected employes?

Generally, the first of these is the best place to start any upgrading of personnel skills. It works better in the later phases of the cooperative efforts between the training agency and company and in addition it provides a common basis for additional "skill" training.

After the objectives of the program are determined, the subjects to be covered are decided upon and the length of time to be devoted to instruction of each subject is set. Committees from the company are appointed to outline material to be covered and to provide instructor-trainees from within the company.

Training personnel, with the company's subject outline as a guide, provide a suggested teaching outline with suggested training aids and methods of instruction for each subject. Conferences between company and training committees arrive at a finished outline and teacher's guide for the subjects to be taught. It is then the job of the training agency to assemble the necessary films, mock-ups, cutaways, working models, slides, charts, books, pass-out materials, etc., needed to begin the teaching.

In the meantime, they also give group instructions to the company personnel who are later to be instructors. These instructions are on teaching methods and usually last at least ten hours.

How to Train

As stated previously, the training department may do the needed training or it may be done by a recognized institution. It is important to know the four steps of training, regardless of who does the training.

The first step of a well-developed training program is "preparation." There are two kinds of preparation needed—the instructor needs to prepare himself and he must know how to prepare the minds of his students to receive the new material.

Preparation of the training includes doing research to obtain

background of knowledge of the course content and fitting sessions into the prepared outline. It may also mean developing or upgrading a staff to do the training. This often requires many hours of work to present a well ordered program.

Another form of preparation is getting the meeting room ready so that those in attendance will be able to see and hear and will be as comfortable as possible.

Timing is important in a well organized program and thus preparation is needed to have all slides, motion pictures, working models and other equipment ready.

Any training program should be outlined on paper and if it is to be presented frequently, it would be wise to prepare the course in manual form. Planning on paper is part of preparation.

Preparation of student's mind includes creating interest and getting attention. Telling an individual or group how they will be affected by the material and why it is being presented is often helpful in creating interest.

Preparation might be considered the most important of the four-step plan of instruction. Much needs to be said about how to create a readiness to learn.

The four steps known to most training personnel are:

1. Preparation
2. Presentation
3. Application
4. Follow-up or test

In the presentation step, one presents new material. This is done through the use of various training methods and aids mentioned above. It is often helpful for the instructor to take a course in the techniques of teaching or the techniques of group instruction.

Of the methods used in teaching, demonstration ranks high where skill is being developed. Illustration may be used when it is not possible to use demonstration or working models. Lecture has merit when correctly used and helps to clarify many situations.

Other methods include questions and answers, practice on the job and drill on the lesson.

Steps 3 and 4, application and test, should be included in any well-planned training program. Case problems, examples and completing assignments all may be included in Step 3. The fourth step should be used by any instructor interested in determining the effectiveness of his training

About the Author

RICHARD W. DONNELLY has organized and taught several petroleum engineering courses with The University of Texas Extension Division. Donnelly received his degree in mechanical engineering at Oklahoma A. & M. College in 1949. He worked with The Texas Company as a petroleum engineer in various fields on the Gulf Coast before joining The University of Texas in April, 1954. Since that time he has instructed in Field Handling of Natural Gas and worked on an organization and instruction in the company-wide training program of Tennessee Gas Transmission Company.

Course Outline for Training in Pipe Line Automation

AUTOMATIC CUSTODY TRANSFER

1. Volume measurement
   a. The metering tank
   b. Weir method
   c. Float-type gages
   d. Positive displacement (p.d.) meters
   e. Dump meter
2. Temperature measurements—electrical methods
   a. Average-resistance method
   b. Spot measurements
   c. Electrical circuits
   d. Pressure-bulb thermometers
   e. Ambient compensation
   f. Tank installations
3. Gravity measurements
   a. Buoyancy method
   b. Differential-pressure method
   c. Continuous measurements
4. B. S. and W. measurements
   a. Dielectric constant method
   b. Installation
   c. Differential-pressure cell
   d. Operation with BS&W monitors
5. Safeguards and accessories
   a. Level controls and switches
      (1) Float switches
      (2) Tank-gage switches
      (3) Pressure switches
      (4) Capacitance switches
   b. Samplers
   c. Power supply
   d. Data handling

METERING PRACTICES

1. Applications of meters
   a. For checking purposes
      (1) Between stations
      (2) Main lines
      (3) Receipt into gathering station
   b. Custody transfer
      (1) Between companies
      (2) Measurement of lease runs
      (3) Loading of tankers, barges, tank trucks
      (4) Type of material
   c. Reasons for using meters
      (1) Increased accuracy
      (2) Reduce operating cost
      (3) Reduce tankage
      (4) Conservation
      (5) Liquid calibration of tanks
2. Positive displacement meters
   a. Piston
   b. Rotary
   c. Gross metering
   d. Temperature compensated
3. Meter installation
   a. Size of meter
   b. Strainers
   c. Air eliminators
   d. Plug valves—quick opening, throttling, non-displacement
   e. Rate valves
   f. Set stop valves
   g. Ticket printers
   h. Automatic—remote transmission
   i. Prover tanks
      (1) Gravimetric
      (2) Volumetric
4. Operation
   a. Personnel
   b. Rates; displacement; pressure
   c. Calibration
5. Proving of positive displacement meters
   a. Equipment
      (1) Prover tank
      (2) Master meter
   b. Procedure
      (1) Operating conditions
      (2) Steps (mechanics)
      (3) Calculations
6. Maintenance
   a. Type of personnel
   b. Regular schedule
   c. Analysis of factor variation
   d. Common causes of meter failure

REMOTE STATION CONTROL

1. Type of control needed
   a. Start
   b. Stop
   c. Thruput control
2. Means of transmission
   a. Leased wire
   b. Radio

efforts. Without this step, he has little way of knowing how successful his methods have been.

Classes usually are held at or near the pipe line station. Enrollment is kept below 20 men to encourage class participation in discussion and to aid in individual guidance while working on actual models of equipment. These first classes are taught by training agency personnel with company teacher-trainees in attendance. Individual instructions are given the company trainees between and after classes and discussions of methods are held.

Company trainees teach in later classes with the training agency men sitting in to provide guidance and assistance. The same procedure is followed with each subject.—**The End**

Where to Get Information About Supervisory Training Courses

COLLEGES AND UNIVERSITIES

Director
Engineering Extension & Placement
Extension Division
University of Alabama
P. O. Box 2787
University, Alabama

Office of the Director
Institute of Industrial Relations
University of California
Berkeley 4, California

Director
Evening Division
College of Business Administration
University of Santa Clara
Santa Clara, California

Dean Graduate School of Business
Stanford University
Stanford, California

Dean
College of Business Administration
University of Denver
1445 Cleveland Place
Denver 2, Colorado

Editorial Assistant
Institute of Labor & Ind. Rel.
University of Illinois
704 South 6th Street
Champaign, Illinois

Dean
Technical Extension Division
Purdue University
Lafayette, Indiana

Engineering Extension Service
Iowa State College of Agriculture and Mechanic Arts
Ames, Iowa

Office of the Dean
Tulane University
School of Business Administration
New Orleans 18, Louisiana

Office of Director
School of Adult Education
University of Omaha
Omaha, Nebraska

Supervisor of Institutes
Community Service & Institutes
The University of Nebraska
University Extension Division
Lincoln 8, Nebraska

Bureau of Occupation Extension and Industrial Services
University of the State of New York
23 South Pearl Street
Albany 7, New York

Graduate School of Business
Columbia University
Arden House
Harriman, New York

Director
Business & Industrial Services
The University of Oklahoma
Norman, Oklahoma

Office of the Dean
College of Business Administration
The University of Tulsa
Tulsa 4, Oklahoma

College of Business Administration
University of Cincinnati
Cincinnati 21, Ohio

Assistant Dean
College of Commerce and Administration
The Ohio State University
Columbus 10, Ohio

Coordinator
Management Problems for Executives
University of Pittsburgh
Pittsburgh 13, Pennsylvania

Associate Professor in Charge
Supervisory Training
Extension Services
College of Mineral Industries
The Pennsylvania State University
University Park, Pennsylvania

Division of University Extension
The University of Tennessee
Knoxville Center
Box 4416, University Station
Knoxville, Tennessee

Dean
School of Business
Texas Christian University
Fort Worth, Texas

Division of Extension
Texas A. & M. College
College Station, Texas

Assistant Director
Petroleum Extension Service
Division of Extension
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Select the Correct Electronic Instrument

New type instruments can handle a number of jobs in telemetering and remote control. They are especially suited for handling data with digital or analog computing equipment.

By **A. J. HORNFECK**
Bailey Meter Company, Cleveland

Growth of automatic control and telemetering points to a growing use of electrical methods of measurement, data transmission, and control on long distance pipe lines. Today, pneumatic systems are commonly used for both control and measurement, but they do have limitations. Data processing, particularly for analog and digital computing, requires use of electrical signals.

What Instruments are Available? The electronic type continuous balance recorder is perhaps the most important single instrument for measurement and control because of its adaptability and accuracy in measurement of all quantities which can be converted to electric signals. Conversion of physical quantities to electric voltages or currents permits transmission of the measurements over relatively long distances either in a large station or between stations. An electronic recorder has almost unlimited flexibility. It can be located in a control and measurement center far removed from the point of measurement.

A diagram of the automatic null-balance system of measurement is shown in block form in Figure 1. Direct current potentiometer circuits are used when the measuring element generates a d-c voltage as the output signal. Typical examples include thermocouples, photocell devices and pH electrodes.

A-C bridge and ratio circuits are used with transducer type elements which convert the physical variable to a change in resistance, inductance or capacitance. Examples of a-c transducers are resistance temperature elements, differential or movable core transformers and strain gages.

All modern electronic type null balance recorders use an a-c servo balance system and consequently are directly applicable to a-c measuring circuits. For d-c measurements it is standard practice to convert the unbalance signal of the d-c type measuring circuit to an a-c signal by means of a mechanical or electronic chopper.

New Multichannel Instruments Handle Many Jobs. Today's electronic receiver recorders are usable with both d-c and a-c measuring elements. They may also be used as telemeter-receivers for both d-c and a-c signals. This instrument is of the multichannel type and is capable of accepting as many as four plug-in receivers in any combination. The same basic instrument may also incorporate pneumatic receivers, mechanical integrators, retransmitting devices of both electric and pneumatic type, contact mechanisms and pneumatic and electric control elements. Careful selection of component elements enables the same basic instrument to perform an almost unlimited number of measurement and control functions.

Non-linearity characteristics inherent in many electrical pickups are extracted by means of a pen positioning cam driven by the servo balancing motor in the receiver units. Thus it is possible to combine four records from d-c as well as a-c measuring elements and also from pneumatic transmitters on the same uniformly graduated chart.

All receiver units are designed as separate plug-in type assemblies to be mounted in any one of the four re-

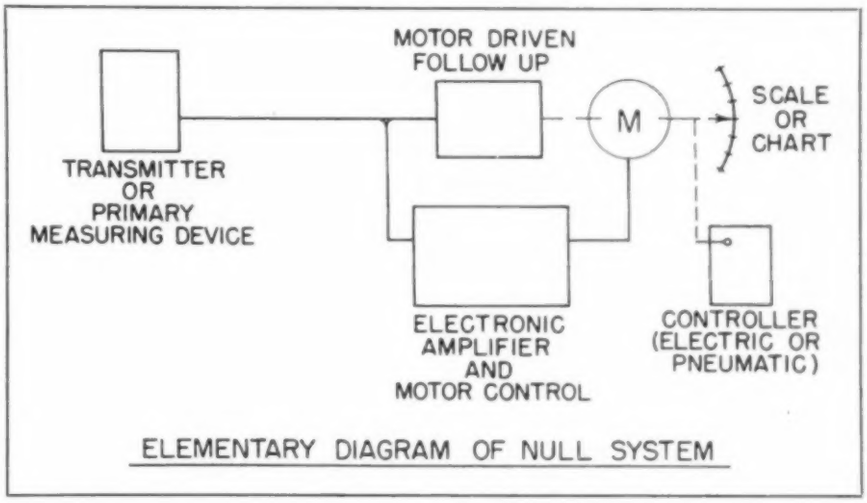


FIGURE 1—Block diagram of an automatic null-balance measurement system. Either d-c potentiometer circuits or a-c bridge and ratio circuits may be used with this system to handle a wide range of measured quantities.

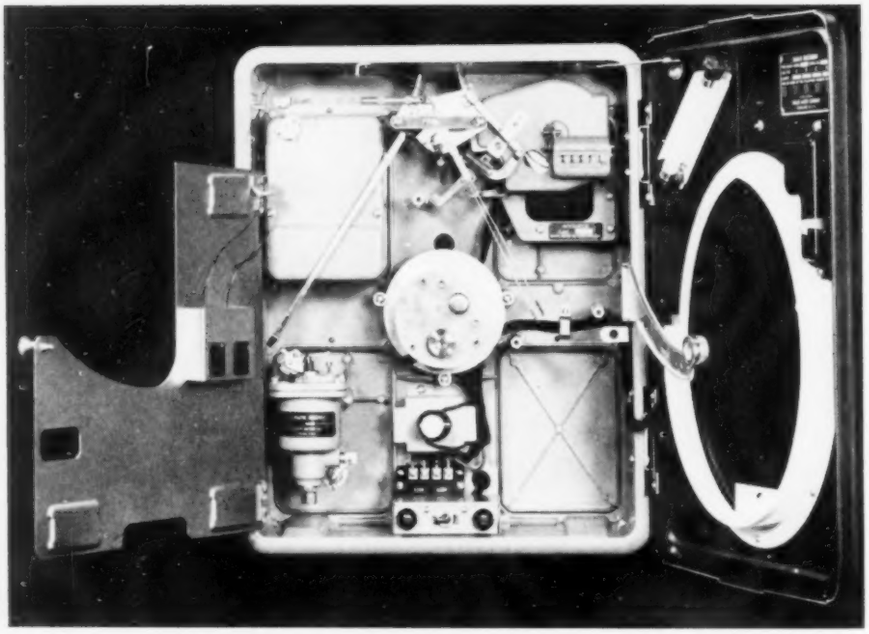


FIGURE 2A—Internal view of an electronic receiver-recorder shows one of the many combinations possible in pipe line control systems.

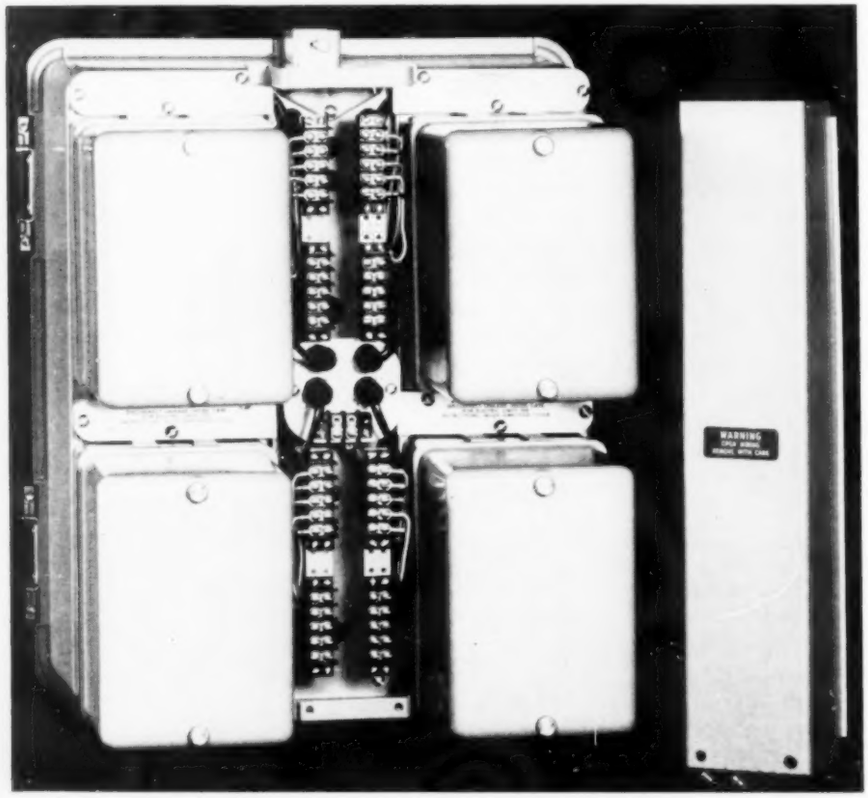


FIGURE 2B—Back view of unit shows plug-in design that permits versatility with a number of elements.

corder positions. These can be interchanged as desired; additional units can be added in any unused position to satisfy additional requirements that develop after an instrument has been put into service.

A number of unit type receiver elements can be used with the standard recorder. The a-c receiver unit has been designed for basic types of electrical circuits. There are many possible variations of these circuit forms to suit particular measurement requirements. Two commonly used ones are shown in Figure 3.

Computations of derived process variables such as Btu rate, flow totals and ratios, non-linear function extractions, input-output relations and the like can be performed by incorporating several transmitting or measurement transducers in simple or complex variations of these circuits.

One of the basic and most frequently used circuits is the d-c potentiometer recorder shown in Figure 3. It is applicable to all measurements which can be converted to a d-c potential. Successful applications include measurements of temperature (using thermocouples), pH, radioactive isotope detection, speed, flow, level, current, voltage, power and many others. The d-c receiver unit is also ideally suited to resistance bridge circuits particularly where the signal level is very low as in the case of resistance strain gage circuits.

Both the a-c and d-c receiver units are completely self-contained packages consisting of the following essential components:

1. Circuit balancing or follow-up element which may be either a resistance slide wire or a movable core transformer.
2. Two phase servo-motor which drives the follow-up element.
3. Circuit wiring board for mounting calibration resistances and for making the necessary circuit connections as determined by the particular measurement application.
4. A servo-amplifier.

In the a-c balance systems the servo-amplifier is basically a simple electronic device which detects and amplifies the error or unbalance signal of the measuring circuit and controls the reversing servo-motor. The d-c unit amplifier consists of the servo-motor control element, a d-c to a-c converter and an electronic reference supply voltage for the potentiometer. An electronic reference supply eliminates the need for standard cells and dry batteries used in most present day potentiometer recorders.

Electronic Control—Advantages and Limitations—While pneumatic control is now widely used in the pipe line industry, it may be expected that there will be an increased use of electric control systems and also systems involving a combination of electric

nal transmission and pneumatic or hydraulic power units.

Pneumatic systems are severely limited for remote control applications because of transmission lag, but no such limitation applies to electric systems. On the other hand there is no electric motor operator or power unit which compares in reliability and low cost with the pneumatic cylinder or diaphragm power units. Nor does it compare in speed of response with hydraulic power elements.

Acceptance of electronic control systems has been retarded by the limited reliability of present day electron tubes. Development of more reliable tubes and the use of solid state devices such as transistors and magnetic amplifiers in place of tubes should make the position of electric control more favorable.

Telemetering Calls For Well Designed Electronic Instruments. Partial or complete automatic control for a system such as a products pipe line often requires transmission or telemetering of measured data over several hundred miles. While complete automatic operation of entire systems by telemetering of measured and control information may not now be considered practical or even desirable, many functions are being performed by such systems.

1. Telemetering is used extensively to transmit measured variables such as pressures, flows, gravity, viscosity, and volumes from several points in a system to one or more central locations to permit centralized monitoring of system operation.

2. Supervisory control from a central point is now widely used to remotely start and stop engines, pumps, compressors, and monitor alarm conditions and faults.

3. Remote automatic control has been applied to many individual units at stations on several systems.

Telemetering Systems Classified by Nature of Data Sent

1. Absolute Value Signal Systems

   a) Current—Value of a transmitted current is caused to vary with the measurement to

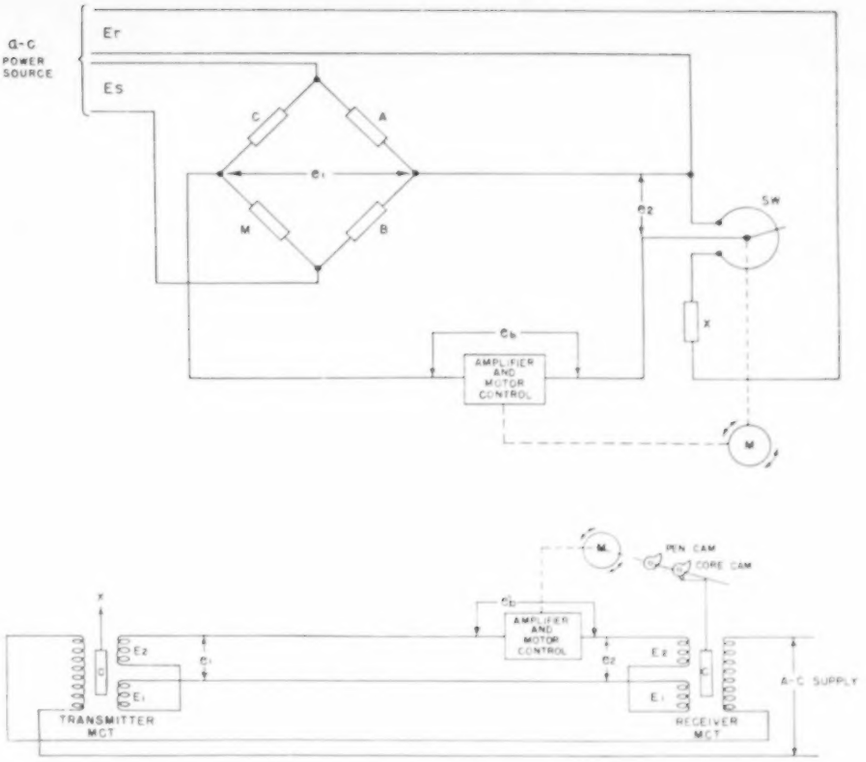


FIGURE 3—Two basic types of electrical circuits used with a-c receiver units. These may be varied to fit particular measurement requirements. By including several transmitting or measurement transducers in circuit variations it may be used to handle non-linear functions such as flow totals on pipe lines.

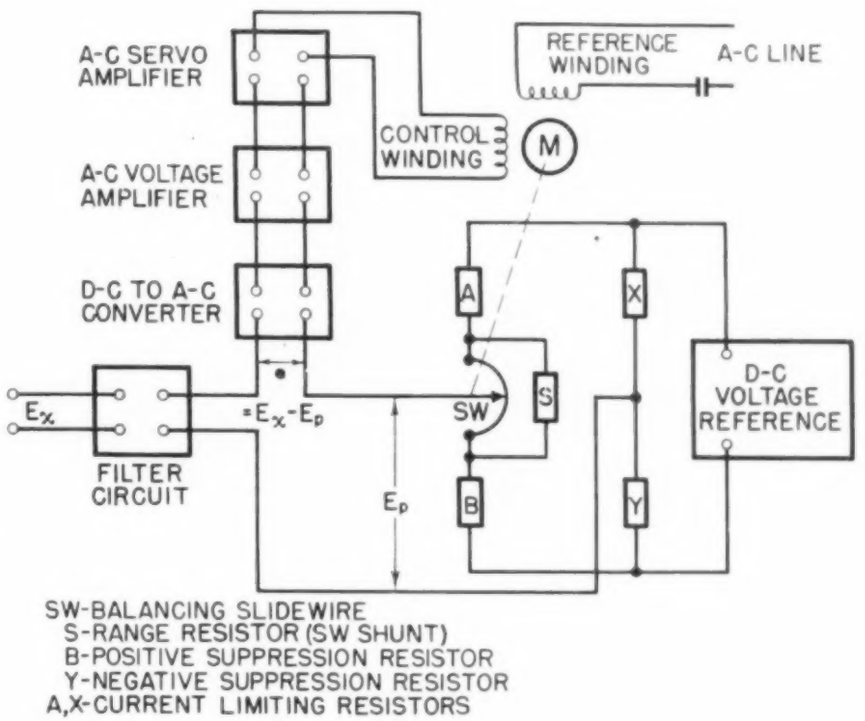


FIGURE 4—One of the most widely used circuits in automatic control is this d-c potentiometer recorder. It is capable of handling all measurements which can be converted to a d-c potential and may be used in combination with electric, pneumatic, or hydraulic units.

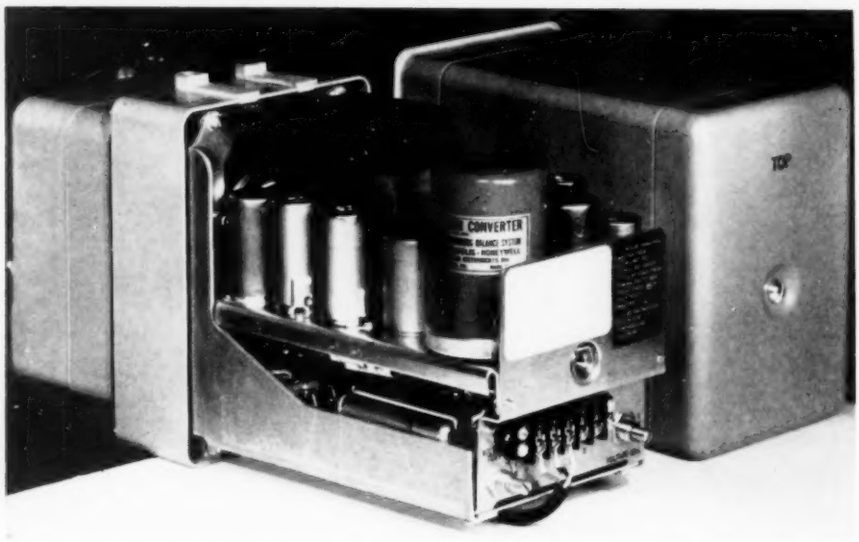


FIGURE 5—Exposed view of typical d-c electronic receiver. Units may be used in several combinations to meet special measurement and control requirements.

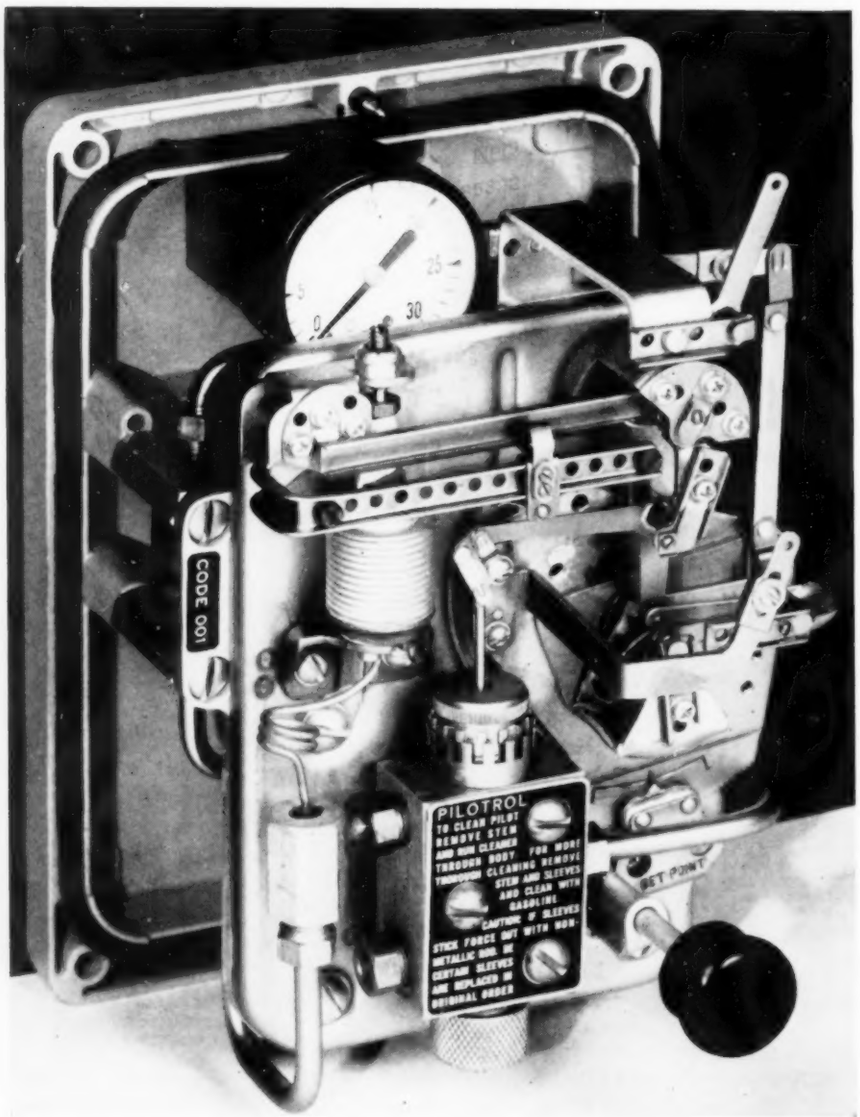


FIGURE 6—Typical pneumatic control pilot unit. A number of electronic and pneumatic components may be used with the standard recorder.

be reproduced.

(b) Voltage—Value of line voltage is caused to vary with the measurement. On distances up to a few thousand feet these quantities may be a-c or d-c. For longer distances only d-c is practical because of the susceptibility of a-c systems to phase shift and interference pickup from adjacent power circuits.

2. **Frequency**—The frequency is made representative of the measurement. Frequency telemetering is used extensively where the transmitting link is via radio.

3. **Position**—Measurement reproduced is expressed as the ratio or magnitude relation of two (or more) electrical quantities in the transmitter circuit.

4. **Impulse**—Value of measurement to be reproduced is expressed as the relation between successive impulses of current or voltage. In impulse systems the transmitted quantity is time rather than electrical magnitude.

In impulse duration systems quan-

About the Author

A. J. HORNFECK has been principally concerned with electronically operated null balance recorders, process measuring and control systems during his years as a research engineer with General Electric Company and Bailey Meter Company. A 1935 graduate in electrical engineering from the University of Pittsburgh, Hornfeck did special laboratory assignments for General Electric for three years. He joined Bailey Meter Company in 1938 as research engineer and is now director of the research laboratory.

ies measured are converted to time cam mechanisms. These instruments have been used extensively in pe line telemetering for a number years. A more recent system uses electro-mechanical sweep balance stem for generating proportional me duration pulse with teletype nsmission. This system, shown hematically in Figure 5, is essenally a combination of local telemeering units of the servo-actuated sition type coupled to a long-dis-ance system. It operates on a general principle called a "time division, pulse coded multiplexing system," by mobile telemetering engineers. Actually, it is also what the point-to-point telemetering engineers designate as an impulse duration multiplex or multipoint system.

In this scheme each measurand measured quantity) is sampled in a sequence by means of a scanner and then transmitted to the final receiving station or stations as a series of coded characters. Each channel of information is identified by the code selected and each measurement of the various quantities is sampled in sequence. They are then transmitted as a complete series of coded characters by converting the width of the pulse, determined by the scanner, into a proportional number of coded characters. The measurands may be either electrical or nonelectrical quantities such as pressure, flow, level, and so forth. Quantities may be converted either directly or through several stages of local telemetering into an electrical quantity proportional to the original variable. Outputs of all the transducing 'or converting elements in the system are of the same nature so that they can be compared against a common scanning function.

The sequence switch continuously connects each of the transducers into the scanning circuit in a predetermined sequence, there a comparison made between outputs and the varying output voltage of the nner. If the output voltage of the kup is directly proportional to the asurand, scanner output during rise period is made a linear function of time. The scanner converts magnitude of the output of each nsducer into a proportional time ilse.

In this system the proportional time interval is represented by the time of dwell of an electric contact. It may also be represented by the period of conduction of an electron tube. This pulse may be transmitted over a wire link. If a radio link is used, an amplitude- or frequency-modulated carrier is required.

Transmitted quantities may be identified at the receiver by their chronological position in a train of impulses such as might be indicated on a cathode-ray oscillograph. In the specific system, developed for pipe line telemetering, identification is accomplished by converting each pulse into a group of coded teletype characters. Coding is accomplished by synchronizing the teletype equipment with the sequence switch. Electromagnetic or electronic counters may be used at either the sending or receiving end to permit digital display of readings integrated or averaged over selected periods of time.

—The End

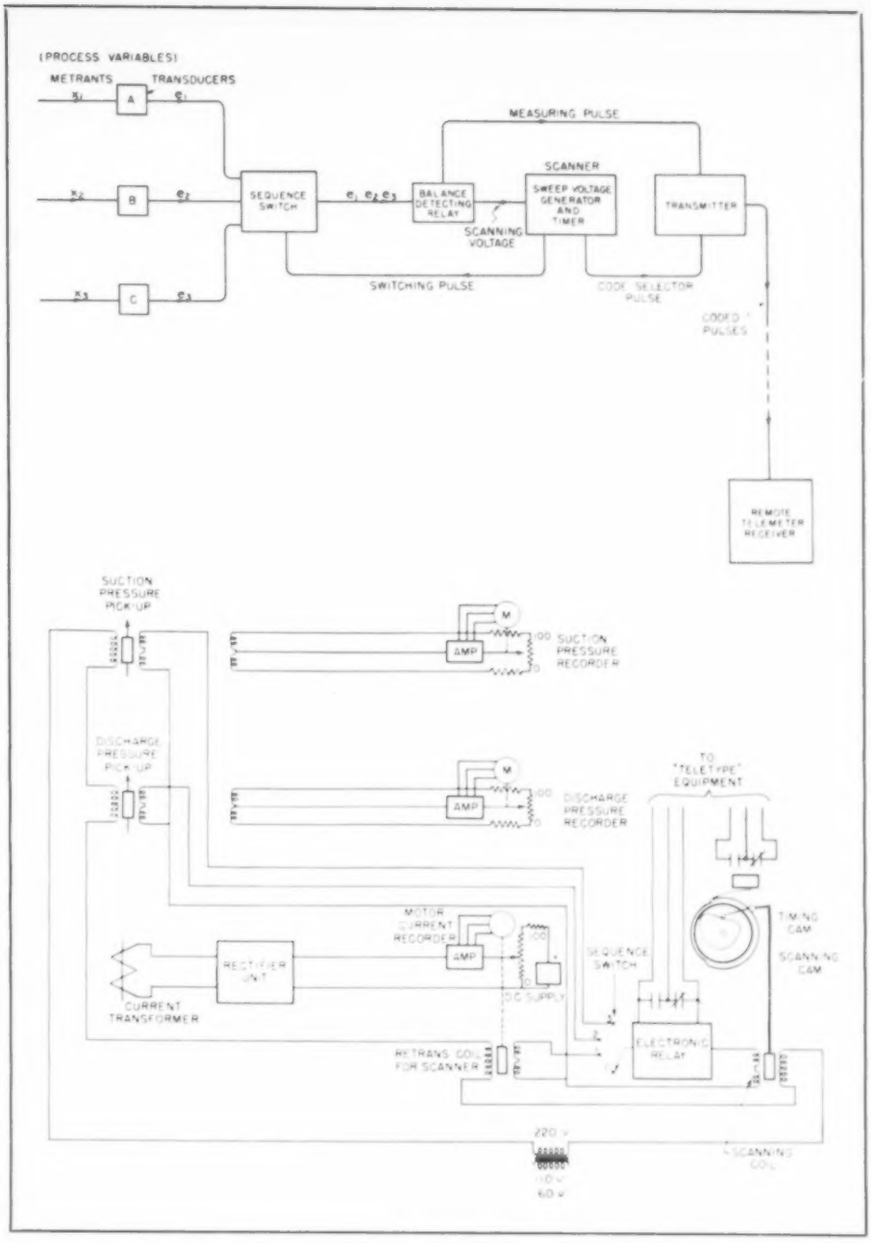
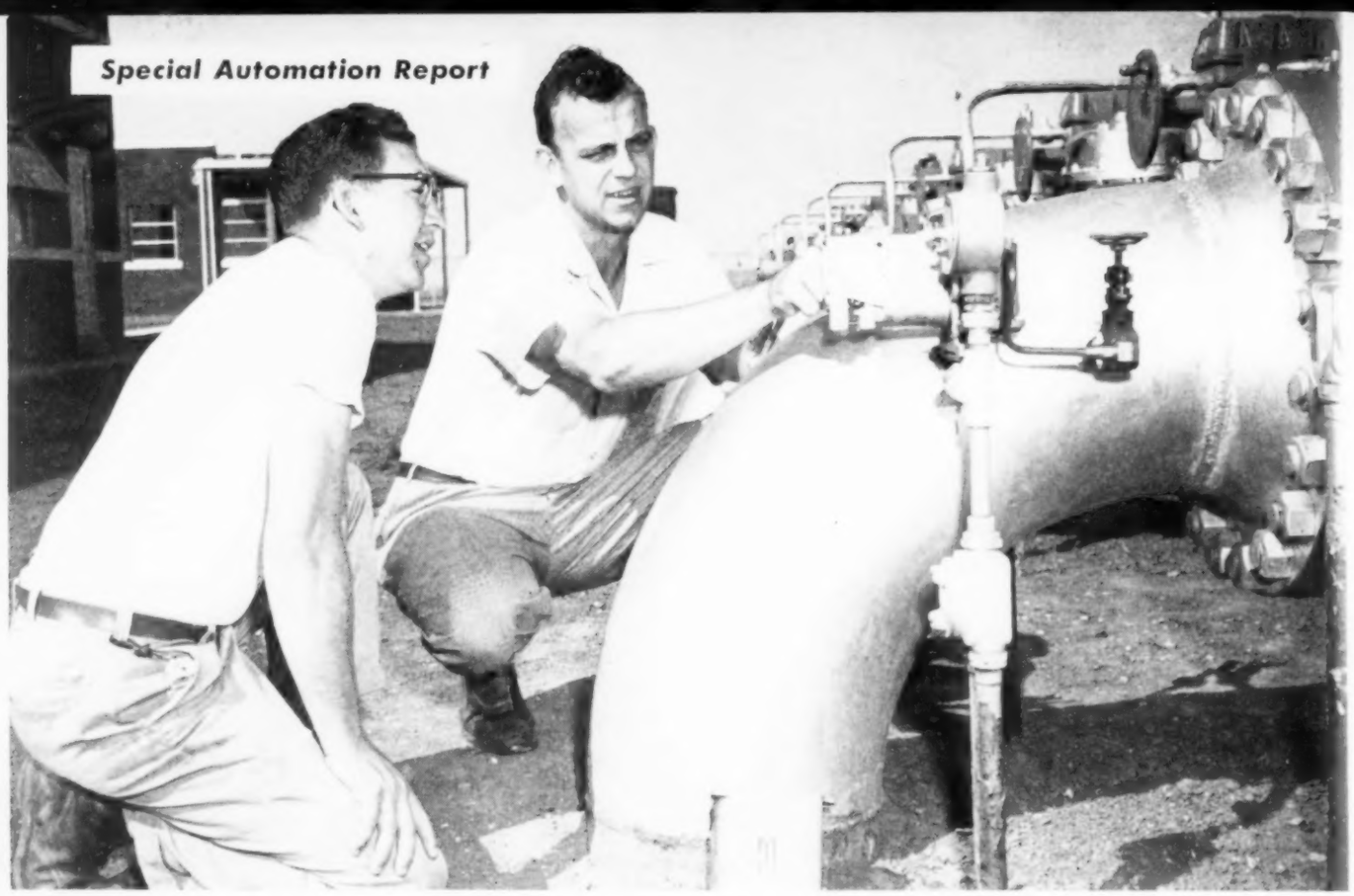


FIGURE 7—Typical schematic circuits for pipe line telemetering systems using teletype transmission. An electro-mechanical sweep balance generates a proportional time duration pulse. The system is essentially a combination of local serve-actuated position type telemetering units coupled to a long distance system.



Designing an automatic control system is only the first part of the engineer's job. Here Fred S. Jones, superintendent of communications for Platte Pipe Line Company points out some of the maintenance features of a pump discharge line pressure transmitter to Walter Graff, resident operator in charge of Platte's Holdrege, Nebraska, pump station. Keeping management informed on economics of control is important, too.

In Automation—Engineer's Duties are Threefold

- To keep management informed on economics and administration.
- To cooperate with operations in design and maintenance.
- To insure that the system is well engineered.

By FRED S. JONES, Platte Pipe Line Company, Kansas City, Mo.

ALL OF THESE duties add up to one obligation—to serve the best interest of the pipe line company. Automatic control will not always be more economical than manual control on every pipe line system. The design engineer must be capable of proving to management's satisfaction the advantages of converting certain functions to automation. To do it he must use good judgment in selecting both methods and equipment.

Management cannot be informed of what automation is doing for the company unless the engineer honestly tells executives the facts. He must advise them how much money is being saved, what sacrifices are being made, what controls can be converted to automatic operation next and other such pertinent points. This is probably one of the toughest jobs an engineer will encounter. He must remember not to get so involved in the switches and relays that he feels he doesn't have time to sit down and write a simple, accurate report on what is being done and what results engineering efforts are achieving for the company. It is not management's fault if the engineer presumes that his efforts are not understood or appreciated. It is the engineer's own responsibility to keep management informed.

Give Management the Facts. Many times the design engineer learns that certain changes should be made to improve the efficiency, safety or dependability of pipe line control equipment. After considering the problem from all angles, he may compile conclusive evidence to point out the action needed. His next job is that of a salesman. To do a good selling job to management, he should present only a few well-chosen reasons known beforehand to be of prime interest to management; then explain both the problem and solution in clear semi-technical terms.

To do a good selling job to management the engineer need not quote a long, boring list of highly technical reasons why certain modifications should be made. Management is not impressed by highly technical double talk, nor should he oversimplify his explanation by reverting to boy-and-dog terms.

There should be nothing more satisfying to an engineer than to overhear management representatives talking to each other in correct technical terminology about a problem and a

lution he has presented. If your esident, vice president or manager marks "I don't know how this rks, but my engineers do," your b is only half done. Your system sign may be the best process control the pipe line industry, but you're ll the nut and bolt man. It would much better of the executive said, Our engineers have worked out this ocess that allows us to push this utton which, in turn, will open these alves and start the motor in the oper sequence with complete safety o men and equipment." Your effective education and salesmanship can influence management to actually sell themselves.

Recognize Equipment Limitations. In spite of the zeal that you may develop in your work, learn to recognize equipment limitations when you see them and be sure to include them in their proper place in your original proposals to management. Every piece of equipment has certain limitations upon what it can and can not do. If management is properly informed of those limitations and extends approval to your project, recognizing these facts, you need not later be embarrassed for having to answer for failure resulting from a known limitation.

On the other hand, if you withhold limitations in the hope of receiving quick approval for your project, and then failure occurs, you alone can be held responsible. Quite possibly the reputation of the entire engineering department is damaged. Remember that limitations expressed before approval are facts; those expressed only after failure are very weak excuses.

Coordination Is Vital. In the past, many pipe line companies have maintained a clearly defined line of responsibility between the engineering and operations departments. This was quite successful until many automatic control processes came onto the scene. With automated processes in use, engineering and operations must work closely together. It might be well for completely automated pipe line system to be run by a single department, possibly designated the engineering and operations department. Either an engineer or operations executive could be in charge to maintain a unity of purpose. That purpose would be to combine the talents of both groups in harmony toward a common goal of successful automatic operation.

However, as long as operating and engineering departments are separate, it is another one of the engineer's responsibilities to maintain a highly effective cooperative attitude toward operations and recognize the problems involved in the operations of an automated system. In such an environment the engineer will need to "volunteer" for many new jobs without assignment.

Here again the engineer must be both an educator and a salesman to assure the success of an automated pipe line system used in operations. people directly concerned with it must have a more detailed knowledge of the equipment and techniques than that understanding required by management.

Routine Maintenance. Routine maintenance is often performed by operations personnel. It is the engineer's prime responsibility to make sure that the maintenance staff is entirely familiar with the workings of all automatic equipment. The operator who pushes a button must know where the relays are that open and close. He should also be encouraged to know which ones, when and why. This challenge presents an excellent opportunity for the maintenance technician and the engineer to work together to instruct the operator. This is the best way to achieve a top performance automatic operation.

A certain amount of salesmanship is needed too, but if the operator knows what is supposed to happen when he pushes a button and the engineering and maintenance is sound, "failure-free" performance will be the strongest sales point of all.

Failure Reports. Prompt, accurate, and unbiased reports of failure or improper operation which may occur in an automated process are the most important by-products of the engineer's educational effort. Without good cooperation with the operations department, the engineer will likely receive a long delayed biased report of questionable accuracy. Throttling valves that closed last week without signal, and an undetected pump seal leak last month generally fall into this classification. They probably will continue to do so if the engineer doesn't assume his training responsibility to operations. Prompt, accurate reports are a must to both the engineer and operator.

If the problem is approached in the right manner, operations executives will agree to and benefit by providing the means for the operator or maintenance technician to contact the engineer directly. Sometimes this will mean that the formal chain of authority maintained heretofore will be by-passed.

Remember Your Responsibility. Before automation, engineering responsibility could be broken down by well defined subdivisions, such as electrical, mechanical, electronic, and others. In companies now employing automation to a high degree, these formal subdivisions often assume secondary import. In the original job of prescribing the technique of control and the selection of equipment, it is best to assign the job to a composite group of engineers and operations men. By doing this each group will benefit from the ideas of others and better harmony will be the result.

Today, automation has brought both advantages and problems to the pipe line industry. Adequate measures must be taken to build harmony between the designers and the operators of automatic systems. Automation will either fail completely or will at best only continue to exist without close cooperation. The engineer can, and should, make a significant contribution to the initial success of automation by going beyond his assigned responsibility to secure the wholehearted cooperation of both management and operations. To do it, he must be in addition to an engineer both a teacher and a salesman.

—**The End**

About the Author

FRED S. JONES, Platte Pipe Line Company's superintendent of communications, was responsible for much of the controls engineering on the company's system. He attended the Navy Radio Materiel School and served as an officer in the Marine Corps during World War II. Jones received a degree in electrical engineering from the University of Kansas in 1950. He then worked as a project engineer for the Midwest Engineering Development Company before joining Platte. Jones owns and operates a licensed shortwave station.

At one end of the communications system—at Sui, where the Pakistan pipe line begins—is this radio tower (background).

Why VHF System Is Used On Sui-Karachi Pipe Line

Costs, temperature and terrain lead operators in Pakistan to this choice of communications.

ALL END-TO-END and intermediate communications along Pakistan's 350-mile natural gas pipe line from the Sui gas field to Karachi depend on a VHF radio-telephone system selected for three reasons:

1. Route of the 16-inch, $150 million pipe line is through both arid and agricultural areas in one of the hottest parts of the world; however, it passes through few cities and no service was available from the nation's telephone network.

2. Burying a telephone cable with the pipe line was described as involving prohibitive costs.

3. Overhead telephone lines would have raised the problems inherent with shifting sand, river crossings, occasional but severe Indus river floods and the need for protecting copper wire.

So, the present VHF system—immune to these disadvantages—was installed on the pipe line, which is Pakistan's most important economic project since it connects one of the world's largest gas fields with the nation's industrial area. Preliminary estimates indicate that more than 100 Mmcf. could be delivered from the field daily for 60 years.

Specifications called for a communication system providing regular and efficient telephone service between the terminal stations at Karachi and Sui, the three headquarter stations and eight repeater gate valve stations. The dispatching staff is located at Karachi and receives four-hourly reports on pipe line pressure from Sui and the eight intermediate stations.

The system also is used for regular administrative and engineering traffic between stations, particularly because normal mail services are not available.

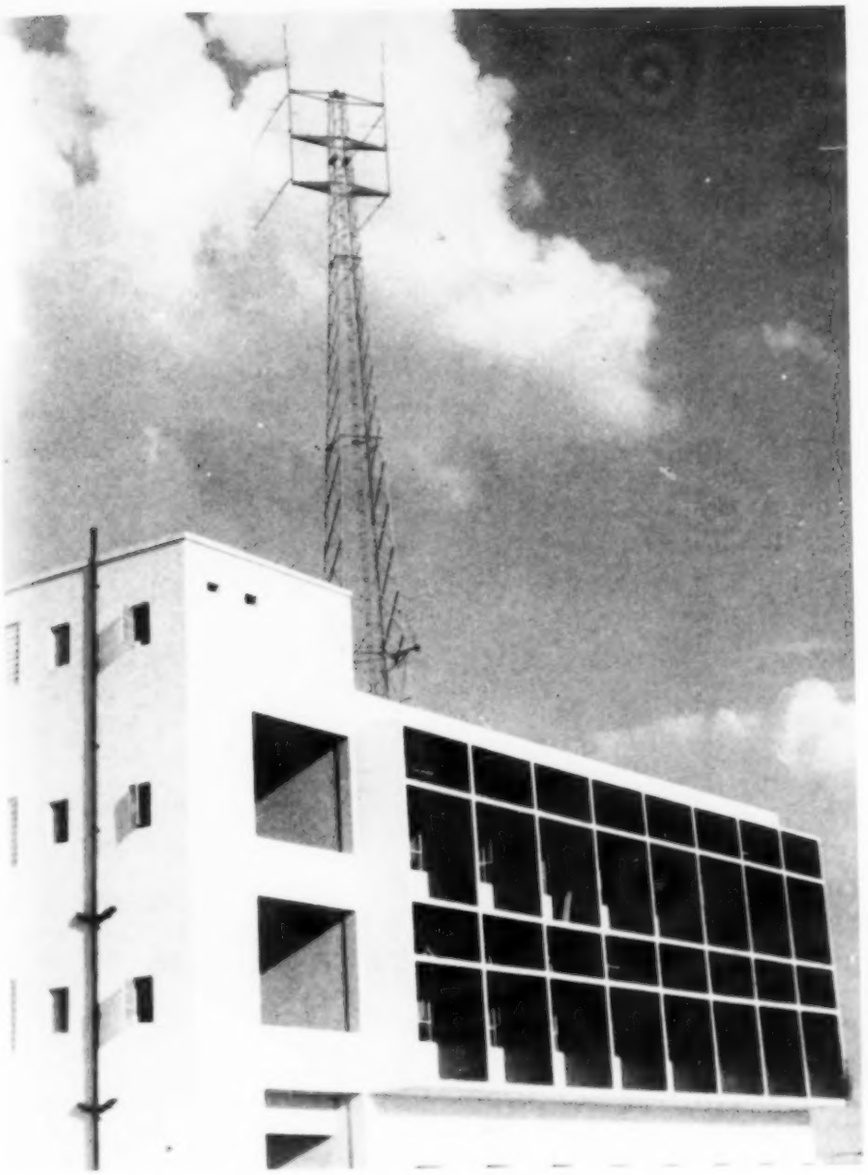
During normal pipe line operation, most communication traffic is routine. It is handled by a teleprinter connecting Sui, Karachi and the headquarter stations so as to eliminate language difficulties in passing along messages. Vehicles assigned to patrol and maintenance along the pipe line are connected by two-way radio, with headquarters and terminal stations.

During special operations such as filling and testing, these vehicles were posted at normally unattended gate valves to maintain contact with the dispatching staff at Karachi.

This communications system provides three principal services:

1. Multi-channel radio telephone between Karachi and Sui, using the eight intermediate stations as relays, provides three speech channels and two teleprinter channels with full standby facilities.

2. Mobile VHF radio telephones for maintenance and service trucks operating along the line. Five principal stations work with the mobile sets and are tied in with the multi-channel radio-telephone system so any mobile set can contact any other fixed or



The terminal tower was built at Karachi, 350 miles from the communications line beginning at Sui.

mobile point on the system.

3. Reserve high frequency system is provided between Karachi, Sui and the midway headquarter station. The backbone of the VHF system is a chain of multi-channel radio links spaced at distances of between 30 and miles, depending upon the terrain. This radio system transmits three carrier channels and one audio circuit. The latter designed as a party line interconnecting all stations in one section of the line. The first carrier channel is used as a direct channel between Karachi and Sui. The second carrier is used as a direct channel in each section. The third is used for telephone traffic.

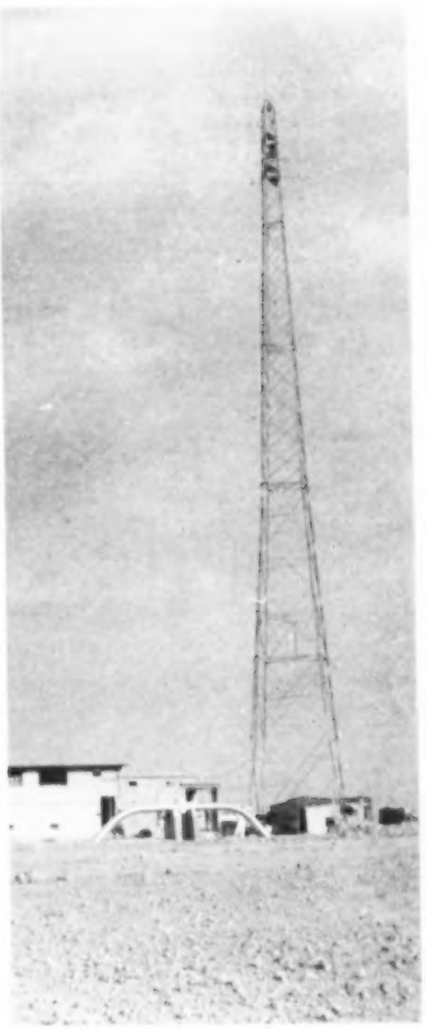
At each major station along the line, the audio circuit and appropriate carrier channels are terminated on a switchboard—a 25-line cordless type at Karachi and Sui and a 10-line cordless type at the headquarter stations.

In offices and living quarters at each station, telephones are provided for local internal communication with access to the trunk circuits. Trunk circuits can be connected through at any station.

Since the traffic between Karachi and Sui depends on correct operation of all intermediate stations, radio equipment was duplicated throughout the system. Each station can be changed over from main to standby status.

Terrain traversed by the pipe line, of course, influenced the planning of the communications system. Starting at Sui, the pipe line crossed open desert for 30 miles, then descending into the Indus valley where rock and sand give way to irrigated paddy fields. The Indus is crossed at Sukkur, 70 miles from Sui, and for the next 160 miles the terrain alternates between agricultural land and arid scrub. For the last 120 miles between Hyderabad (Sind) and Karachi, the route lies over rocky desert with low ranges of hills. The entire region is extremely dusty, and summer temperatures of 115° F. are normal. Slight rainfall averages six inches a year. The winter climate is reasonable.

Initially, a theoretical assessment was made of the signal strength to be expected over each link of the pipe line communications system. Due to unknown terrain factors, the value of these theoretical calculations was limited. A radio survey team, consequently, was sent to conduct tests between the sites to be used—even



Between the beginning and the terminal points lies this intermediate station with pipe line and gate valve visible.

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This is a maintenance and patrol vehicle, equipped with mobile radio unit.

before the pipe line was laid. Station sites had to be found with the aid of marker stones.

Each of two teams of engineers was equipped with a 90-foot portable mast with Yagi antennae, cables, gasoline-electric generator, camping equipment, and radio test gear. Each of the nine link stations was tested for periods of up to 72 hours. It was found that the 70 Mc/s frequency band was most suitable. The initial planning was based on the use of 150-foot towers at each station, and survey measurements indicated the heights were adequate.

Meanwhile, more than 50 tons of radio, carrier and telephone apparatus had arrived in 500 packing cases, in addition to 50 tons of steel for the ten 150-foot towers.

Erection of the towers and Yagi antennae required 11 weeks. As soon as the buildings at each station were completed, radio equipment was moved up country and unpacked.

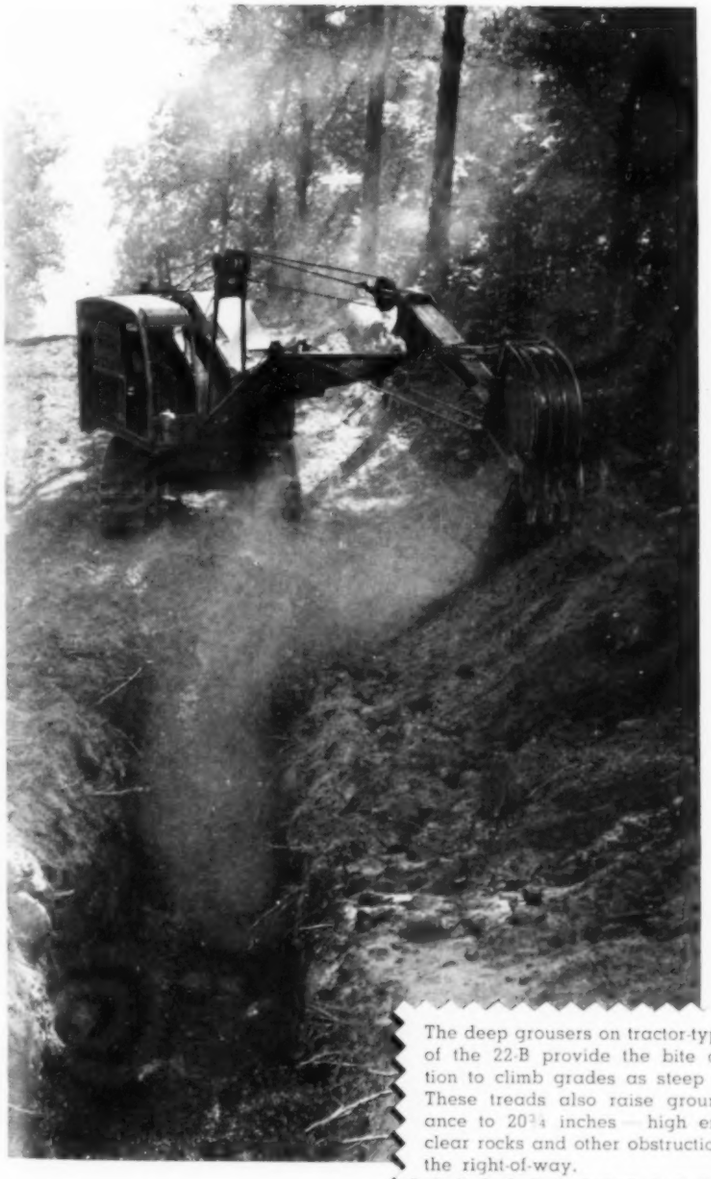
As power from the pipe line became available at each station, equipment was tested and put into service. At this stage, station buildings and power supply arrangements were far from complete and standby radio equipment at each station was not in commission. But it was decided that the VHF system would be reliable enough for the filling and testing of the pipe line.

Gas was turned into the pipe line at Sui, and its progress was detected at each gate valve and reported back to Karachi. Pressure rise was reported hourly. Two leaks in the line occurred, and faulty sections were isolated immediately while new sections were welded in.

The pressure in the line then was raised to 1070 psi and checked for leaks during the next 24 hours. The Karachi end was then vented to the atmosphere through a flare. The flame reached a height of 200 feet, and could be heard from a distance of eight miles.

That was the crucial phase, and it confirmed the reliability of the VHF communications system whose value was later reconfirmed during extensive flooding from monsoon rains.

For fast, on-time pipeline trenching Bucyrus-Erie 22-B Dragshovel



When tough-going threatens your trenching schedule—that's when a Bucyrus-Erie 22-B dragshovel really pays off. Here is true rugged construction to match high-speed digging power—a combination that keeps jobs on schedule mile after mile.

That rugged dependability is there because it's built right in to start. Research, engineering and manufacturing facilities unsurpassed in the industry are back of every 22-B that goes to work.

You can see this leadership in the outstanding features of the 22-B: tapered dipper with high side cutters and tough teeth loads full and fast and dumps clean and quick . . . strong cambered boom supplies extra, time-saving reach . . . smooth, vibration-free control responds to fingertip touch to help operators deliver rapid work cycles. And most important, a 22-B is built to stay on the job with minimum maintenance.

Put a 22-B dragshovel to work on your next job and watch it set the pace on trenching. Your Bucyrus-Erie distributor will give you all the facts on this dependable ¾-yd. machine.

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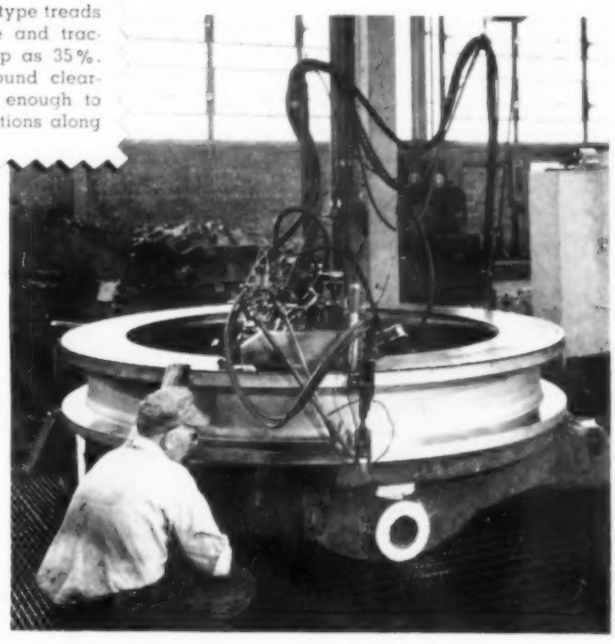
The deep grousers on tractor-type treads of the 22-B provide the bite and traction to climb grades as steep as 35%. These treads also raise ground clearance to 20¾ inches—high enough to clear rocks and other obstructions along the right-of-way.

Bonus Quality

is built into every part of a Bucyrus-Erie machine. For example, this automatic machine is flame-hardening the lower path for the hook rollers to insure long life and low maintenance.



BUCYRUS ERIE

South Milwaukee, Wisconsin

FIGURE 1—View of welding test set-up at Service Pipe Line's Tulsa shops. In this test, failure occurred in the fusion zone between the weld metal and patch and liquid under high pressure sprays from the crack.

Better Repair Welds on High Test Pipe

Extensive tests at Service Pipe Line shops point up the best procedures for making maintenance welds on operating lines. Follow these recommendations to eliminate underbead cracking on completed welds.

By A. M. HILL and F. W. ZILM
Service Pipe Line Company
Tulsa

CHEMICAL AND physical properties of high test line pipe present a real problem in maintenance welding on oil lines because of the quenching effect of the fluid. Frequent underbead cracks rule out those established practices used for welding on Grade "B" pipe. Through this series of tests, Service Pipe Line Company adopted recommended procedures that produce high quality welds.

Early in 1955, Service began a testing program at its Tulsa shops to solve the problem of underbead cracking of arc welds on branch connections and reinforcing sleeves. Test welds were made under conditions simulating, as nearly as possible, those encountered in the field. Spot welds, various size patches, and full encirclement sleeves were made on chambers fabricated from 24-inch OD pipe manufactured in accordance with API Specifications 5L and 5LX. During welding, test chambers were cooled with a mixture of water, anti-freeze, ice and salt. Brine was circulated by a pump during the welding operation. After welding was completed welds were inspected for underbead cracks either with magnetic particles, or by sectioning 100 percent of the weld into coupons which were then broken in the weld zone to expose the root bead.

In addition, several chambers were subjected to destructive tests by hydrostatic pressure. To simulate field conditions, an internal pressure of 500 pounds per square inch was maintained in the larger chambers while patches and sleeves were welded

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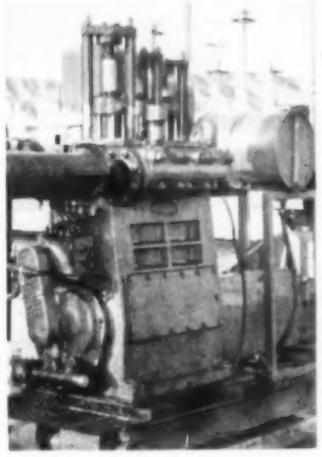

Shown above is one of a number of Aldrich 5" stroke, Triplex Pumps installed at a major west coast water injection project. These pumps are currently handling 35,000 bbl daily at injection pressures of 1,000 psi.

THE ALDRICH PUMP COMPANY

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FIGURE 2—Test cylinder of Grade X52 metal with patches of the same material just before hydraulic pressure was applied beneath welded patch.

Chambers which were tested to destruction with hydrostatic pressure were constructed so that the pressure in the chamber was exerted in the space between the sleeve or patch and the chamber wall. Some destruction tests were conducted while the assembly was cooled to approximately 32° F.

What Tests Show. Results of tests show that high yield strength pipe is very sensitive to the quenching effect of liquid contained in the test chambers. Underbead cracking occurred in all except one test specimen made with E6010 and E7010 electrodes. These electrodes are used for field welding pipe joints and normal maintenance welding on lines laid with Grade "B" pipe. There was also a pronounced increase in the hardness of pipe metal in the heat affected zone.

A repair patch or a branch connection saddle welded onto the high-test pipe tends to reduce its ultimate strength. There is a concentration of stresses in the fusion line of the weld parallel to the axis of the pipe. Tests also showed that high-test pipe is not suitable for fabricated piping systems such as manifolds, pump headers, etc., unless close control of pre-heating and interpass temperature is maintained.

In several tests underbead cracking occurred in the fusion zone between the weld beads and the base metal on welds made with E6010, E7010, and E9010 electrodes. These electrodes are unsatisfactory for welding on a line pipe manufactured in accordance with API Specification 5LX Grades X46 and X52 where it contains liquid under pressure. Welds consistently free of underbead cracks were obtained with E7016 low hydrogen electrodes, both the conventional and iron powder type.

Type E6010 and E7010 electrodes are not satisfactory for welding on API Specification 5L Grade "B" line pipe full of liquid at temperatures as low as 25° F.

TABLE 1
Carrier Pipe Data API 5LX Grade X52 Pipe 24" OD, .312" Wall Thickness Chemical Analysis (Per Cent)

	(Per Cent)		
	Ladle	Check 1	Check 2
Chemical Analysis			
Carbon	.270	.300	.29
Manganese	1.210	1.250	1.11
Phosphorus	.020	.018	.01
Sulphur	.030	.035	.02
Carbon Equivalent	.573	.613	.56
Physical Properties			
Yield Strength	60,620 psi		
Tensile Strength	89,890 psi		
Percent Elongation in 2"	27.5		

Patches and Sleeves
(Corners of all patches were cut on a radius.)
API Grade "B" Pipe 24" OD .500" wall thickness
API Grade "B" Pipe 24" OD .312" wall thickness
API 5LX Grade X52 Pipe 24" OD .500 wall thickness
API 5LX Grade X52 Pipe 24" OD .312 wall thickness
Welding Electrodes
AWS E6010 5/32" Diameter
AWS E7010 5/32" Diameter
AWS E9010 5/32" Diameter
AWS E7016 5/32" Diameter (Low Hydrogen Conventional)
AWS E7016 5/32" & 1/8" Diameter (Low Hydrogen Iron Powder)

Advantages Listed. Satisfactory results were obtained using both the conventional E7016 low hydrogen electrodes, and the E7016 low hydrogen iron powder electrodes. However, the iron powder rod has many advantages over conventional low hydrogen electrodes:

1. **Greater Deposition Rate**
   Using 1/8-inch diameter iron powder electrodes the deposition rate per linear inch of weld is equal to that of the size 5/32-inch diameter conventional low hydrogen electrodes.
2. **Less Operator Fatigue**
   Iron powder electrodes can be used in all positions without oscillating. This gives the operator better control of the weld puddle and results in a deposit of weld metal having a smooth surface and contour. Fluidness of the molten metal of the convention allow hydrogen electrodes requires close observance and controlled manipulation of the electrode by the welder when welding in the overhead and vertical positions. This fluidness plus the necessity of manipulating the electrode results in a weld bead having a very uneven surface. Undercutting of the base material adjacent to the weld bead is also a problem.
3. **Ease of Cleaning**
   Beads of weld metal deposited with

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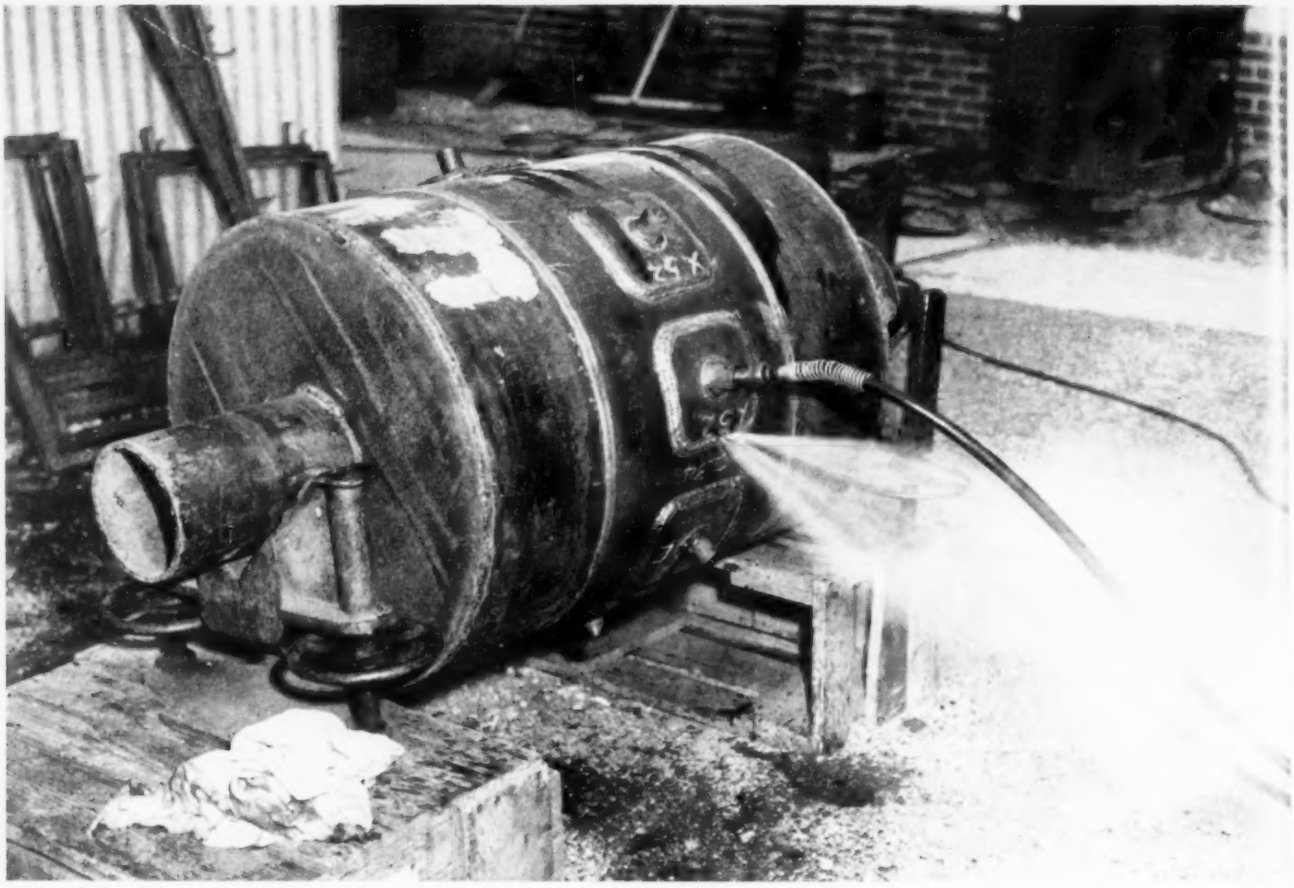

FIGURE 3—Underbead crack revealed in hydrostatic test of patch welded with E9010 electrodes. Chamber had been cooled to 30° F during actual welding.

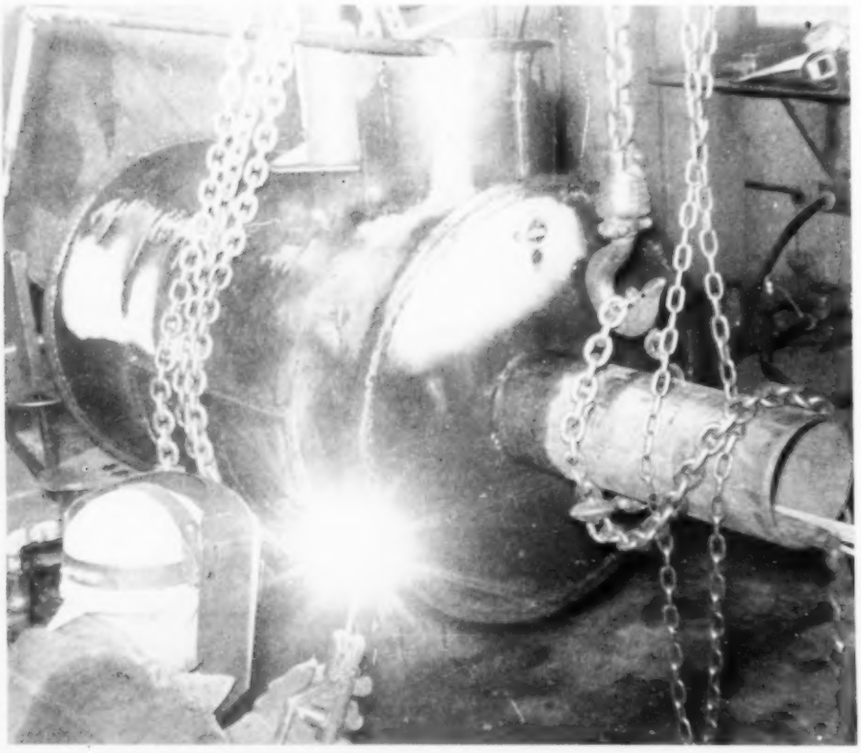

FIGURE 4—Bottom half of encirclement sleeve being installed on test chamber of Grade B pipe cooled to 32 F. Some frost is still visible on upper section of pipe.

the iron powder electrodes have a smooth contour that facilitates slag removal. With conventional low hydrogen electrodes it was necessary to use hammers and chisels to remove slag from the rough surface of the weld beads, especially where undercutting occurred. Slag remaining on or adjacent to a weld increased the difficulty of handling the molten metal when depositing additional beads.

4. **More Effective Inspection**
   Tendency of the slag to adhere tightly to the weld metal deposited with conventional electrodes can hide porosity and undercutting in or adjacent to the welding bead.
5. **Elimination of Porosity**
   Porosity in the weld metal was a problem with the conventional low hydrogen electrodes, particularly when restarting the arc after changing electrodes. Depositing more weld metal over such areas tends to increase porosity rather than remove it. This trouble did not occur when the iron powder electrodes were used.

Welding Procedure Sought. Service's shop tests were made to establish a welding procedure that would

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FIGURE 5—Failure in fusion zone between the 48 by 16-inch patch of Grade B pipe and the weld on Grade X52 pipe. Weld was made at 32 F with a pressure of 500 pounds per square inch then increased to 1450 pounds when failure occurred.

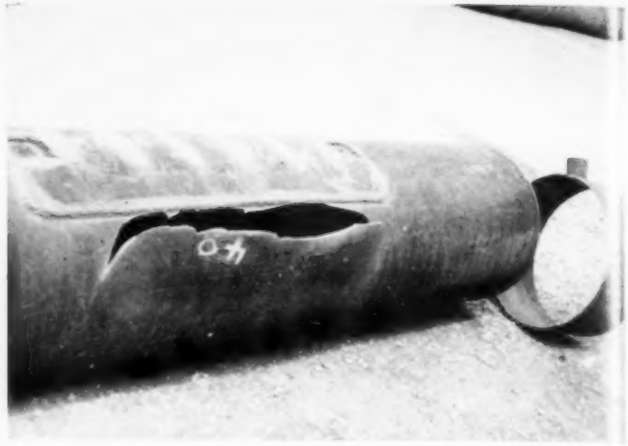

FIGURE 6—After repairing the "pit" that caused the failure shown in Figure 5, a second pressure test was made on the chamber. At 1500 pounds the pipe ruptured parallel to the long side of the patch near the weld.

be dependable for making repairs to corroded pipe, installing new connections, and performing general maintenance work on pipe lines laid of high-test line pipe.

The tests proved that welding materials and procedures currently used are not satisfactory for repair and maintenance of line pipe of API specifications 5L and 5LX in Grades "B," X42, X46, and X52, where the surface temperature of the pipe is below 50° F.

Hydrostatic tests conducted on chambers proved that fittings constructed to completely encircle the pipe will consistently withstand higher internal pressures than the reinforced saddle type fittings. The practice of repairing corrosion pits on common grades of 5L pipe by filling pits with weld metal or by welding patches over them should be restricted to low and medium carbon grades of pipe.

FIGURE 7—A full encirclement sleeve of 0.500 inch wall Grade B pipe is welded onto a Grade X52 chamber cooled to 32 F using E7016 electrodes. A pressure of 500 pounds per square inch was maintained during welding and then increased to 1500 pounds. At that pressure failure occurred at the caps.

GUIDE FOR MAINTENANCE WELDING OF CRUDE AND PRODUCTS LINES

1. **For API 5LX Pipe, Grades X46 and X52**
   - Use fittings that completely encircle the pipe when making repairs or installing new connections onto a line. This holds true regardless of pipe size.
   - Use E7016 low hydrogen iron powder electrodes for all welds which are fused to the wall of the pipe.
2. **For API 5L Grade "B" and 5LX Grade X42**
   - Use fittings that completely encircle the pipe when making repairs or installing new connections on pipe 12¾-inch OD and above.
   - Use E7016 low hydrogen iron powder electrodes for all welds fused to the pipe wall, if the surface temperature of the pipe is below 50° F. E6010 electrodes may be used for welds which are fused to the pipe wall, providing the surface temperature of the pipe is above 50° F.

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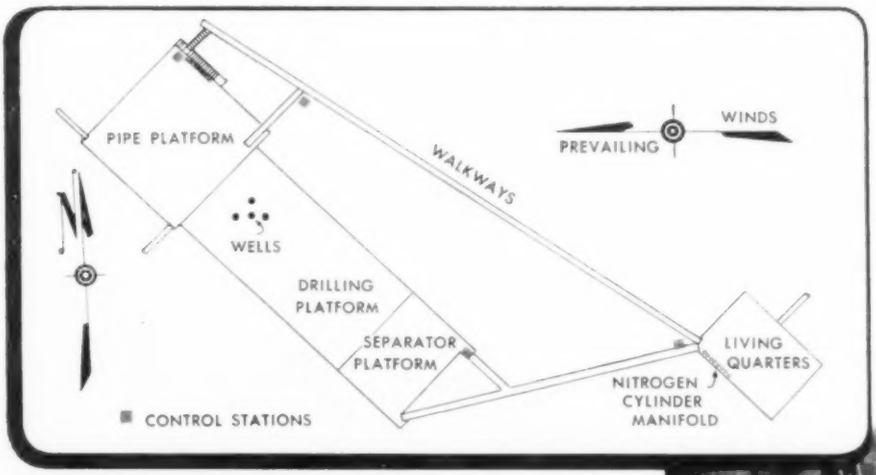

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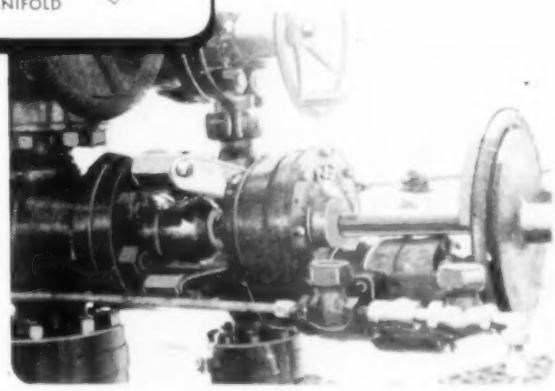

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3. **For All Grades of Pipe**

- Longitudinal seams of fittings designed to encircle the pipe should be equipped with a steel backup strip to prevent the weld metal deposited in these seams from fusing to the wall of the carrier pipe.
- Carefully check all completed welds for underbead cracks with dye penetrant material.
- Line operating pressure at location of welding should be reduced to 200 psi before any welding is started. This pressure is not increased until all welding is completed.

How Tests Were Made

Test No. 1—Grade "B" Patches on X52 Pipe. Patches made from Grade "B" .312 wall pipe were welded on a Grade X52 pipe chamber filled with water at a temperature of approximately 50° F. One patch each was welded with E6010, E7010, E9010, and E7016 electrodes. Upon completion of welding, hydrostatic pressure was applied to the area between the patch and test chamber. Test setup is shown in Figure 1. In all cases the failure occurred in the fusion zone between the weld metal and the patch.

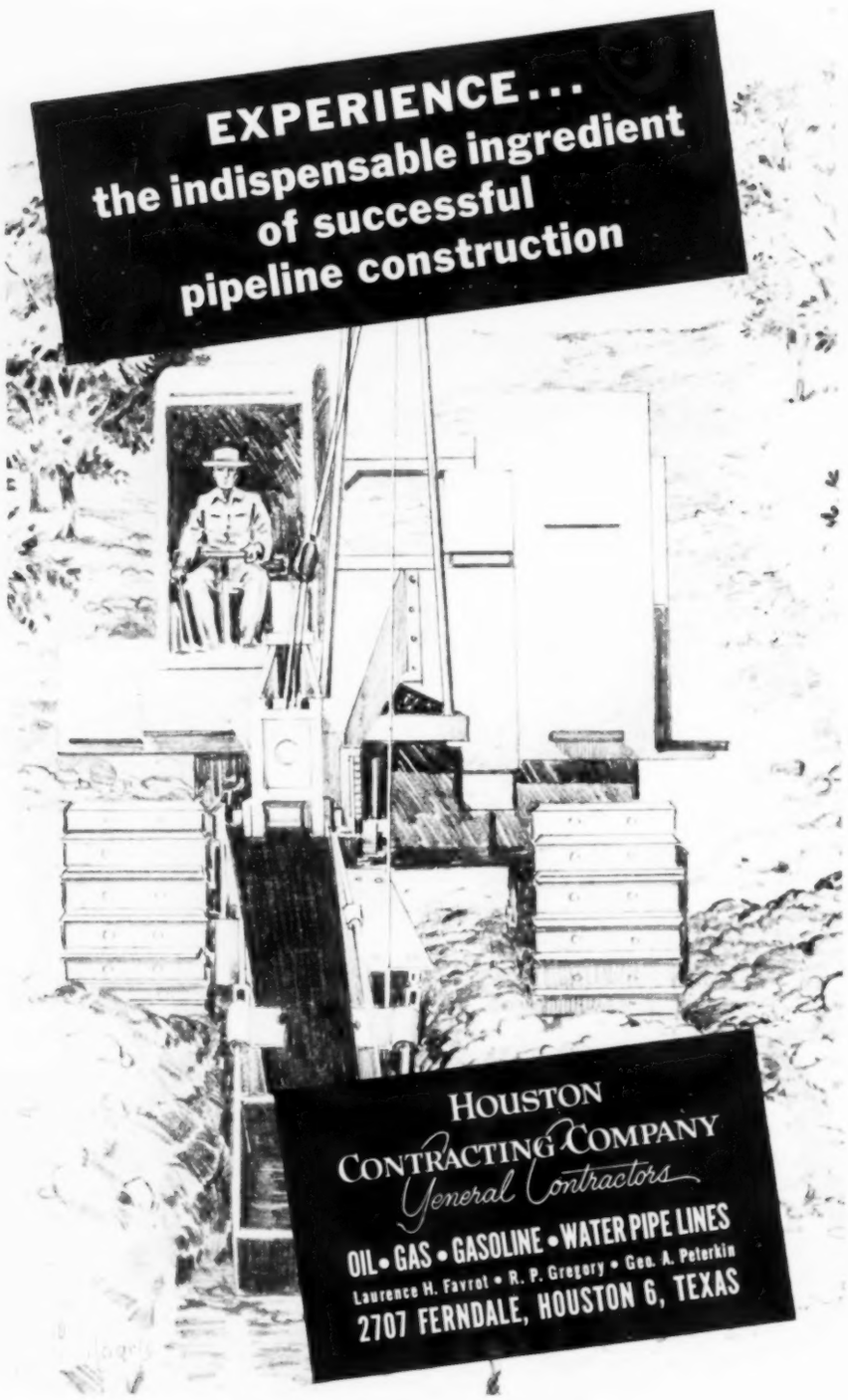
Test No. 2—Grade X52 Patches on X52 Pipe. This test was identical to Test No. 1 except that Grade X52 material was used for the patches. Failure occurred at the fusion zone between the weld and the pipe on all patches with the exception of those welded with E7016 electrodes. With these electrodes the test chambers ruptured underneath the patch.

Test No. 3—Spot Welding "Corrosion" Pits. In this test various size holes were drilled partially through the wall of the chamber pipe. It was then filled with water and temperature was reduced to 50° F. Holes were spot welded to simulate the repair of corrosion pits on a pipe line. In addition, several patches were welded to the chamber to simulate conventional repair work, using various types of electrodes. Several weld beads of both single and multiple pass layers were deposited on the surface of the test chamber.

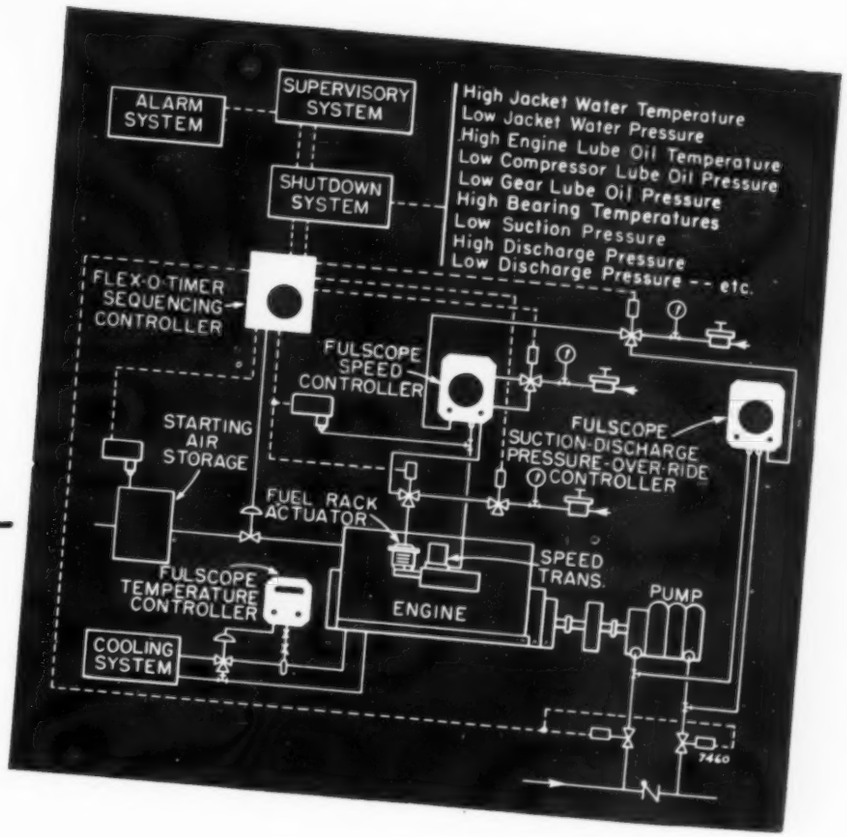
Weld beads were ground flush with the surface of the pipe and examined for cracks by magnetic particle inspection. Patches were tested with hydrostatic pressure applied to the area between the patch and the test chamber. This inspection revealed underbead cracking of all beads deposited with E6010 and E7010 electrodes. No underbead cracking occurred in the weld metal deposited with E7016 and E9010 electrodes.

Test No. 4—Patches and Pit Repairs at 30° F. Here the test chamber was cooled to approximately 30° F. Patches and pit holes were welded similar to those in Test No. 3 except that E9010 and E7016 electrodes were used. Hydrostatic tests, physical, and magnetic particle inspection of the welds shown in Figure 3 revealed underbead cracking occurred where weld metal was deposited with E9010 electrodes. No underbead cracking occurred with E7016 electrodes.

Test No. 5—Full Encirclement Sleeves. Full encirclement sleeves of Grade "B" pipe were welded to a test chamber cooled to 32° F. using E7016 electrodes. Frost collected



A dream materializes—



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on the surface of the test chamber prior to installing sleeve.

Figure 4 shows bottom half of sleeve being welded.

The entire length of both the circumferential and longitudinal welds were sectioned and examined by making a reverse bend of the sleeve sections in relation to the surface of the test chamber. With the exception of some minor cracks at the area where tack welds were deposited, no other evidence of underbead cracking was found.

Test No. 6—Pressure Weld With Grade "B" Patch on X52 Pipe. One 24 inch by 12 inch, and one 48 inch by 16 inch patch made from Grade "B" pipe, were welded to a Grade X52 pipe chamber which was cooled to 32° F. and pressured to 500 psi. Upon completion of welding, pressure in the chamber was increased to 1450 psi. At that pressure failure occurred in the fusion zone between the 48 inch by 16 inch patch and the weld as shown in Figure 5.

The hole in the test chamber which allowed the pressure to equalize between the chamber and the patch, was plugged by welding, and the chamber was again pressurized. During the second pressure test, failure occurred at 1500 psi in the test chamber adjacent to the weld at the edge of the 48-inch patch. In this failure the pipe ruptured parallel to the long side of the patch. Figure 6 shows the rupture. It was approximately 29 inches in length, and tore circumferentially around the test chamber for 6 inches at each end.

Test No. 7—High Pressure Test with Grade "B" Patch on X52 Pipe. The section of pipe which ruptured in Test No. 6 was removed. A new section of pipe was inserted in its place to maintain the original length of the test chamber. Hydrostatic pressure was again applied. Failure occurred in the fusion zone between the weld and the edge of the 24 inch by 12 inch patch at a pressure of 2000 psi.

Test No. 8—Bead Inspection of Failures in Full Encirclement Sleeve Tests. A full encirclement sleeve made from Grade "B" pipe, .500-inch wall, 24 inches in length, was welded with E7016 electrodes onto a 20 foot Grade X52 pipe chamber cooled to 32° F. A pressure of 500 psi was maintained in the chamber during the welding operation.

Upon completion of welding, and while the chamber was still cool, the pressure was increased to determine the maximum amount of pressure a repair sleeve of this type would withstand. When a pressure of 1500 psi was reached failure occurred in the weld adjoining one of the weld caps to the pipe. The sudden release of water pressure blew the weld cap a distance of approximately 75 feet. Simultaneously, the shock wave of the water and gas contained in the chamber caused failure in the weld of the other cap at the opposite end of the pipe as shown in Figure 8.

Procedure used in making these welds was as follows:

Root beads were deposited with $\frac{5}{32}$-inch diameter E6010 electrodes. The second bead (hot pass was applied immediately using $\frac{5}{32}$-inch diameter E7010 electrodes. Remaining beads were deposited by the submerged arc process. No pre-

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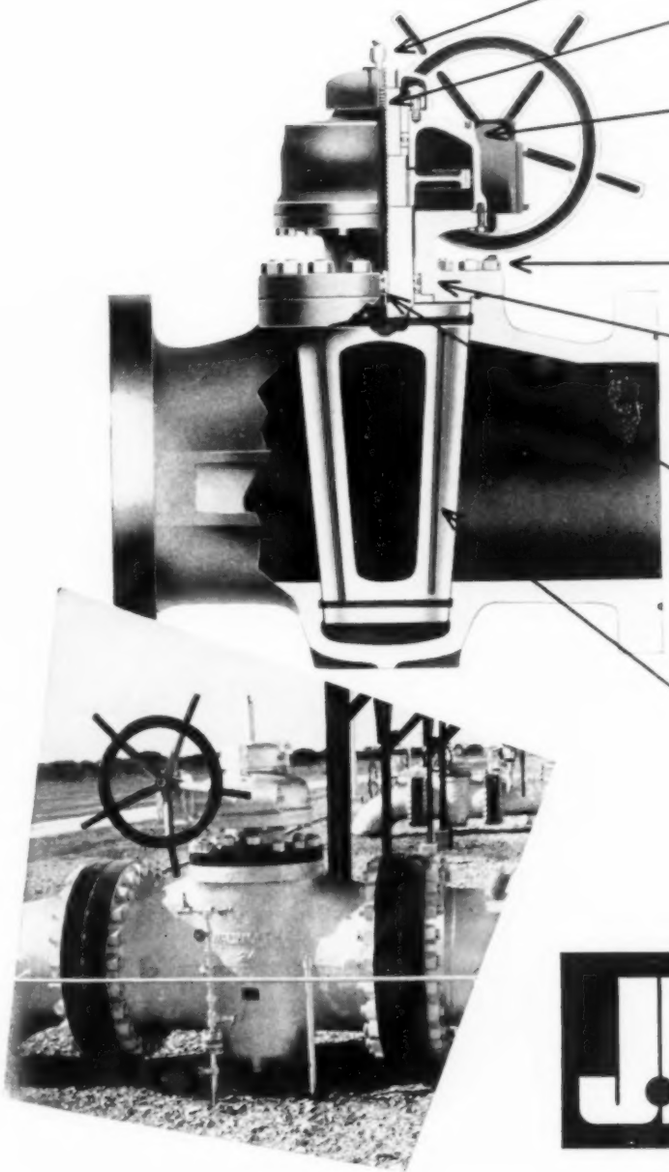
LET'S EXAMINE WALWORTH LUBRICATED PLUG VALVES



Button-head lubricant fitting and lubricant screw. Screw is not removed when using a Walworth High Pressure Lubricant Gun

Lubricant-Fitting screw has "Telltale" safety groove

For buried pipelines this yoke design permits simple attachment of handwheel and lubrication extensions without modifying the gearcase

Standard bolt threads, rather than special threads, permit easy replacement from local stocks

Two overlapping Teflon packing rings form an effective seal against leakage without "grabbing" the plug shank. Packing serves only as a seal and is not used to hold the plug in its seat

In the stainless steel check valve unit, a transverse pin holds two balls in their seats. There is no chance for line pressure to get into the lubricant system when the valve is properly adjusted and lubricated

Lubricant grooves completely frame the port openings and encircle the plug at the top and bottom, assuring a tight seal against leaks. Bottom circumferential groove is separate from, but connected with, the lubricant well

ADVANTAGES OF PLUG VALVES

1. Quick Opening.
2. Positive seal on Light Hydrocarbons.
3. Less space than Gate Valves.
4. Available in Three-Way and Four-Way.
5. Can be used with Locking Device.

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FIGURE 8—In one test a weld cap was blown 75 feet from the test chamber. The one on the opposite end was cracked by the force of the shock wave in the water.

heating was used as the ambient temperature was about 80° F.

In determining the cause of these failures, we reconstructed the order in which the welds were made. The second weld that failed was completed first. Close inspection of the cross section of the weld metal showed that the root and second beads in an 18-inch segment of weld had cracked. The remainder of the weld was of good quality. It is evident that the heat input to the base material, after deposition of the root and second beads, had not dissipated beyond the critical range for most of the weld length before the submerged arc was applied to deposit the third bead. Close examination of the other weld disclosed that the root and second beads had cracked throughout their entire length. This weld was the last to be completed on the test chamber. It is logical to assure that the heat input of the submerged arc would induce an expanding force sufficient to crack the root and second beads after the base material had cooled to the critical point.

This is substantiated by similar welding difficulties encountered in constructing lines laid with X52 pipe. Often after the pipe had cooled to ambient temperatures the root and second beads have cracked soon after the welder starts the third bead. This trouble is more likely to occur at the start of the day, when atmospheric temperatures are below 50° F.

Test No. 9—Retesting Cap Welds With Pre-heating. Weld metal remaining on the weld caps and pipe in Test No. 8 was machined off and new bevels made. The weld caps were then replaced on the pipe and welded after pre-heating the weld areas to approximately 350° F. E6010 electrodes were used for the root pass and E7010 electrodes for the remaining passes. These welds were inspected by radiography and no defects were located.

The chamber was refilled with liquid and hydrostatic pressure was again applied. When a pressure of 2200 psi was reached failure occurred in the longitudinal weld of the encirclement sleeve as shown in Figure 9.

Higher pressure could have been attained had the assembly been so designed to permit 100 percent penetration of the weld metal at this point. Lack of penetration was deliberate, in that we did not think it advisable to fuse or penetrate the chamber with a welded seam parallel to the axis of the pipe.

Test No. 10—Patches and Sleeves Welded With Low Hydrogen Iron Powder Rods. This test was conducted to determine the handling characteristics of E7016 low hydrogen iron powder electrodes; also to find out whether or not it was pos-

This rugged new engine has been added to the Wisconsin line to fill the horsepower gap between the Model VF4 25 hp. and the Model VG4D 36 hp. Wisconsin Engines. At the same time, the mounting base is dimensionally identical to the Models VE4 and VF4 to permit convenient replacement of the latter engines if greater power is required.

The Model VH4, which now makes its bow for the first time, is the most powerful engine of its type and size available today, in our estimation. It is an engine of basic High Torque design which gives it the important advantage of being able to deliver maximum usable *Lugging Power* that carries the load through the hard, heavy pulls. It has been designed to give you the best possible performance at all engine speeds from 1400 to 2800 rpm., even when operating under intermittent shock-loads or under constant load, continuous service.

The Model VH4 is a heavy-duty engine in all respects, built for hard service under all operating conditions, at temperatures from sub-zero to 140° F. (60° C.). It is an exceptionally smooth-running, even-firing engine and has all the traditional heavy-duty features that characterize *all* Wisconsin Models, from 3 to 36 hp. It can be supplied as an "open engine" with side-mount fuel tank, or as housed power unit and may be equipped with electric generator and starter (or starter only), clutch, reduction or clutch-reduction assemblies . . . and is adaptable to operation on a variety of fuels such as gasoline, kerosene, natural gas, Butane, Propane or fuel oil of 35 Octane rating or better.

Learn more about this new engine. Write for Bulletin 5-196 for detailed data and engineering specifications.

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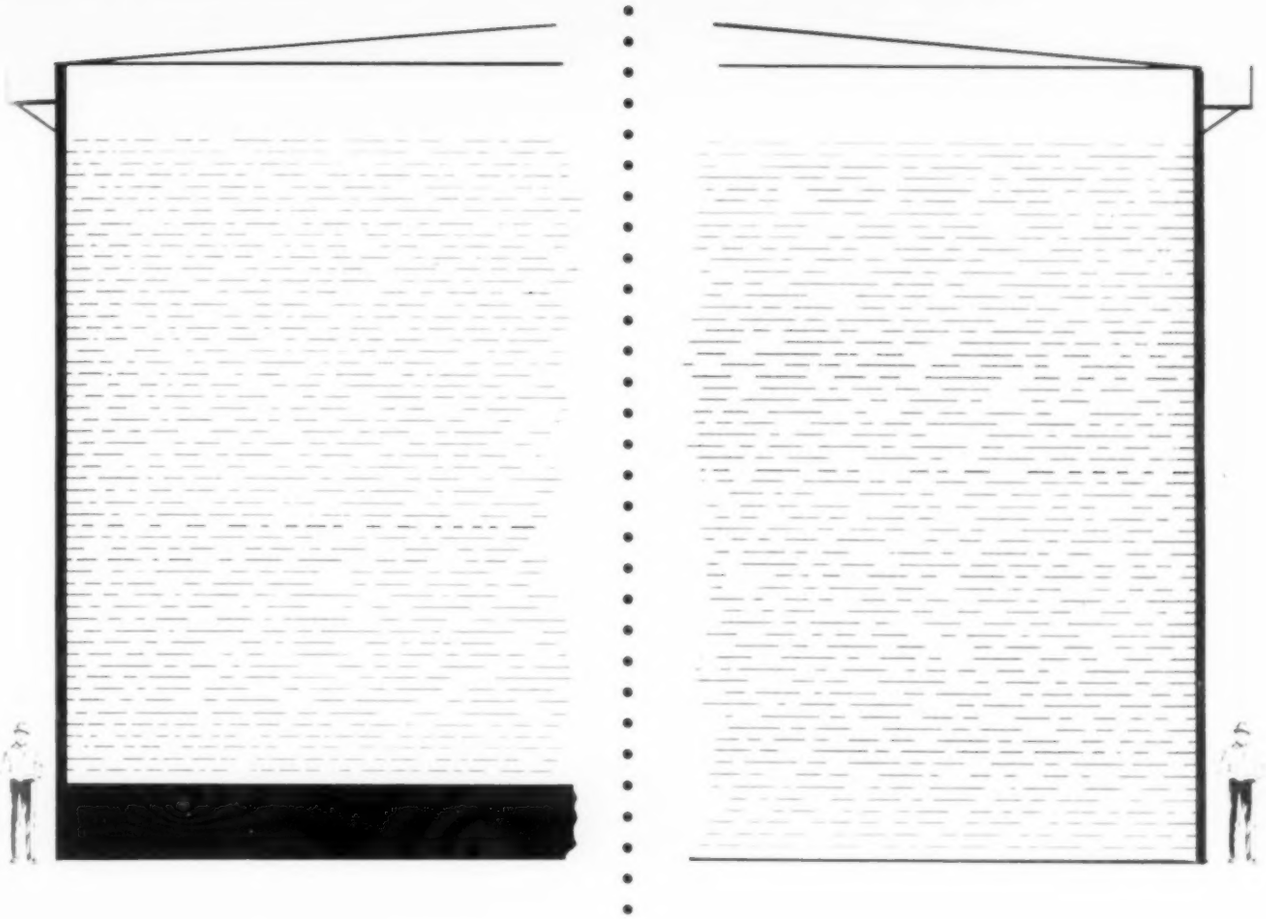

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Also, which tank looks like *yours?*

In the crude storage tank on the left, a three-foot buildup of bottom sediment is using up 5% of the tank's holding capacity.

Before long, this tank will be out of service for cleaning—another dead loss of 3½ to 5% in working capacity.

Cleaning out the sludge costs money, too. And you usually throw out merchantable material *with* the sludge.

How to stop sludge buildup

The tank on the right shows what happens when you install a propeller-type LIGHTNIN Mixer. The mixer propeller turns over the entire tank contents gently and thoroughly—holds paraffin and other heavy components off the tank bottom and keeps them dispersed uniformly. The stream leaving the tank contains the same values that entered the tank.

Results? No more costly downtime for cleaning your tanks. Full tank storage capacity always available. You eliminate the expense and mess of tank cleaning. You realize full value on *all* components of the crude you handle.

Here's how little it costs

You can stop sludge losses in any tank—permanently—for roughly the cost of *a single tank cleanout!* This is why so many pipe line companies find LIGHTNIN Mixers a profitable way to boost tank-farm efficiency, cut maintenance costs for good.

How much can *you* save? Your LIGHTNIN Mixer representative will be glad to show you, without cost or obligation, just what you gain by installing LIGHTNINS on your tanks. For quick, competent help, phone him today. (He's listed in your copy of Composite Catalog.) Or write us direct.

Lightnin® Mixers

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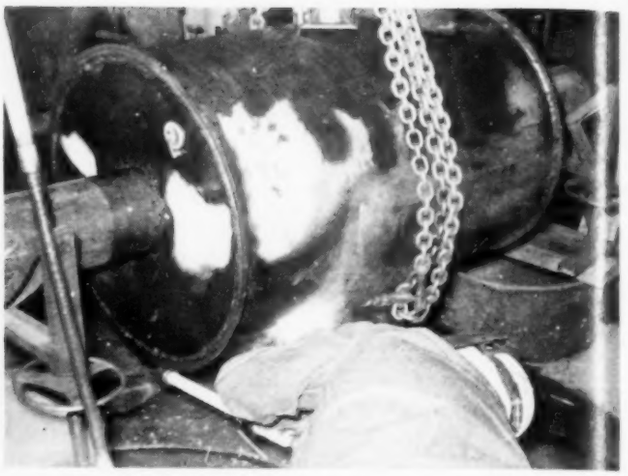

FIGURE 9—Weld failure in the longitudinal seam of encirclement sleeve. It occurred at 2200 pounds per square inch. Higher pressures might have been attained had the assembly been designed to permit 100 percent penetration of the weld metal.

FIGURE 10—Physical tests were made on weld metal deposited from E7016 low hydrogen iron powder electrodes. Here a sleeve is welded onto a test chamber cooled to 25 F. No underbead cracking occurred with these electrodes.

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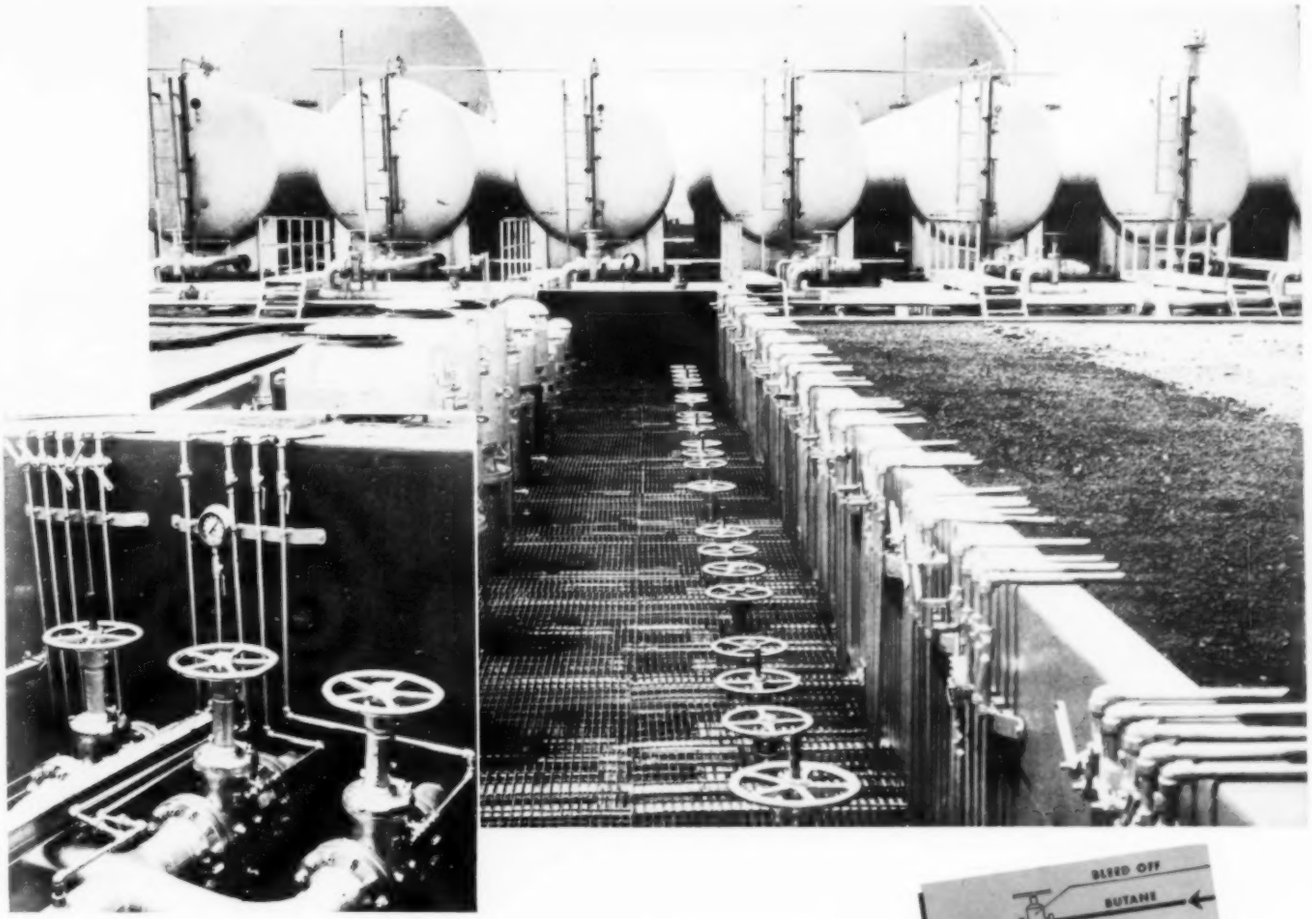
sible to obtain welds free of underbead cracks using these iron powder electrodes. (These electrodes were not available when this testing program was started.)

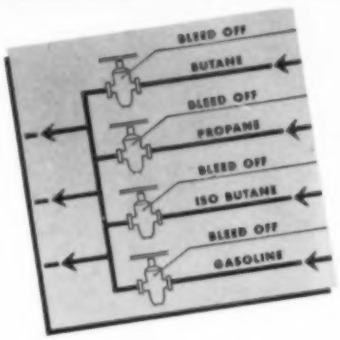
Various size patches and full encirclement sleeves were made of Grade X52 .312-inch wall pipe welded to test chambers made of the same material. Test chambers were cooled to 25° F. Physical tests conducted on the entire length of the weld metal revealed that no underbead cracking has occurred.

Test No. 11—Sub-freezing Welding on Grade "B" Pipe. To determine the effects of maintenance welding on lines of API 5L Grade "B" pipe carrying liquid at temperatures below freezing, various size patches were cut out and welded to chambers of this same material. Chambers were cooled to a temperature of 25° F. and maintained during welding. Both E6010 and E7010 electrodes were used.

Welds were examined for underbead cracking by sectioning the entire length of the weld and making reverse bends in the weld area of each section. Underbead cracking was found at two locations under the weld on a 16-inch by 33-inch patch. One crack was about 1/4-inch in length, and the other was 5/8-inch in length.

Test No. 12—Non-destructive Inspection Methods. This test was conducted to determine the most prac-





A SINGLE W-K-M VALVE PROVIDES DOUBLE BLOCK AND BLEED PROTECTION

W-K-M non-lubricated gate valves with parallel expanding gates and TEFLON* seats seal vapor-tight on both the upstream and downstream seats, regardless of the direction of pressure. This provides the same protection as two conventional valves in a double block and bleed hookup. As the illustration above shows, the bleed line is attached to the body through a tapped opening, thus making it possible to bleed the body completely while holding securely a different gaseous or liquid product on each side of the valve. In addition, the stem on W-K-M rising stem valves is out of the body—to permit lubrication of the threads for easier opening and closing. The valve stem also serves as an "open"—"closed" indicator.

When you use W-K-M valves in such installations you save from ⅓ to ½ in valve costs and also save in piping and hookup time; in operation there is only one valve to handle instead of two.

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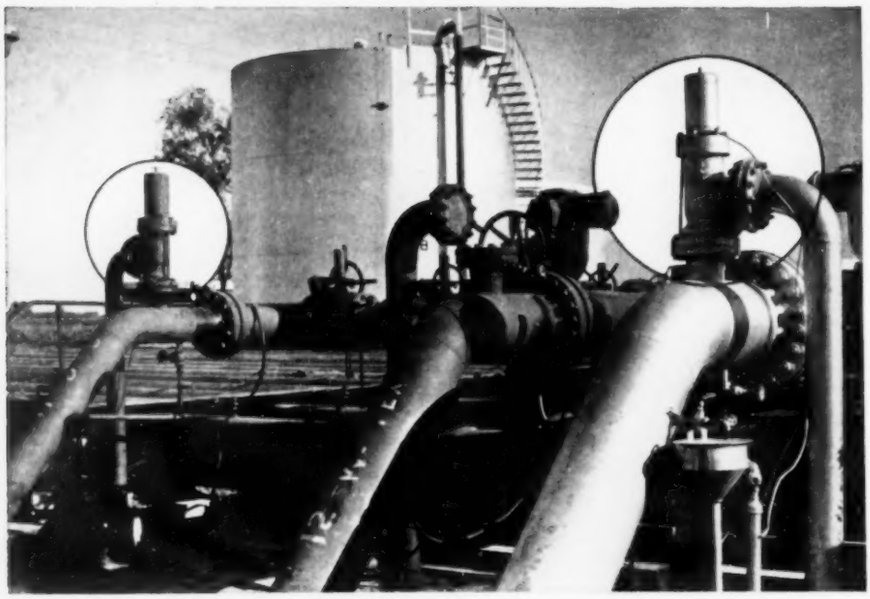

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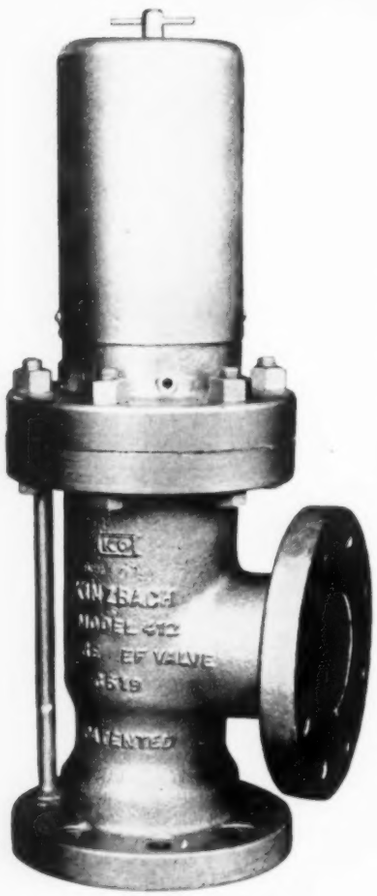

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When a pressure overload in the line is reached, the Kinzbach Model 412 Relief Valve opens instantly to full capacity. This valve provides automatic resetting at a pre-determined pressure drop, positive seating and facilities for functional testing.

The Model 412 uses line pressure for opening and closing. The opening pressure is pre-set by application of a dead weight load. Opening and closing action is positive and reliable. The pre-set pressure never changes.

Kinzbach Model 412 Relief Valves are available in 2", 3", 4", 6" and 8" sizes for working pressures up to 1000 p.s.i. Write for Bulletin RV412 for full technical data.

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tical non-destructive method of inspecting repair welds for underbead cracking on pipe lines full of liquid under pressure. Patches cut from Grade X52 pipe were welded to a Grade X52 pipe chamber cooled to 25° F. Welding was done with E6010 and E7010 electrodes.

Experience gained in earlier tests revealed that cracking would definitely occur under these conditions. On some patches, cracking occurred in the fusion zone between the weld metal and the patch before the welds were completed. Cracks were visible to the naked eye.

On completed welds where cracks were not visible to the naked eye, dye penetrant material was used as an inspection medium. This inspection exposed several cracks in the fusion zone between the weld metal and patch and others between weld metal and the chamber.

Test No. 13—Dye Penetrant Material for Weld Inspection. To determine whether dye penetrant material would consistently expose underbead cracks, two size 16-inch by 33-inch patches of Grade "B" pipe were welded to a Grade X52 pipe chamber cooled to 25° F. Size ⅛-inch low hydrogen iron powder electrodes were used for welding in this test.

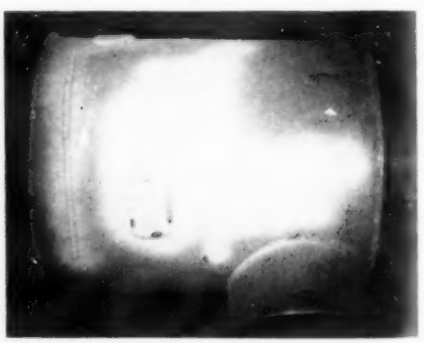

FIGURE 11—Dye-penetrant material was used to inspect those welds where cracks were not visible to the naked eye. Inspection exposed several cracks in the fusion zone between the weld metal and the patch, and in some cases others between the weld metal and the chamber.

Welds were inspected by dye penetrant material as shown in Figure 11. Inspection revealed that no cracking had occurred. The entire length of the weld was then sectioned and examined by making reverse bends of the sections. No cracks were found in the test.

ACKNOWLEDGMENT

Presented at the 11th Petroleum Mechanical Engineering Conference, sponsored by the Petroleum Division ASME, Dallas, Sept. 23-26, 1956.

Maloney PIPE LINE SCRAPER CUPS

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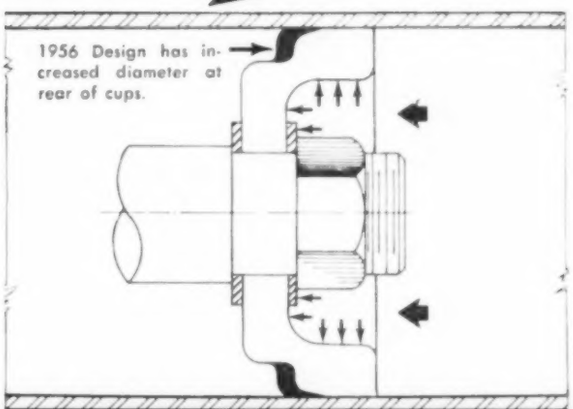
Maloney scraper cups are manufactured from a selected Neoprene compound, have excellent abrasive qualities, proper flexibility and retain dimensional stability under all service conditions. The Maloney 1956 design has increased the diameter at rear of cups.



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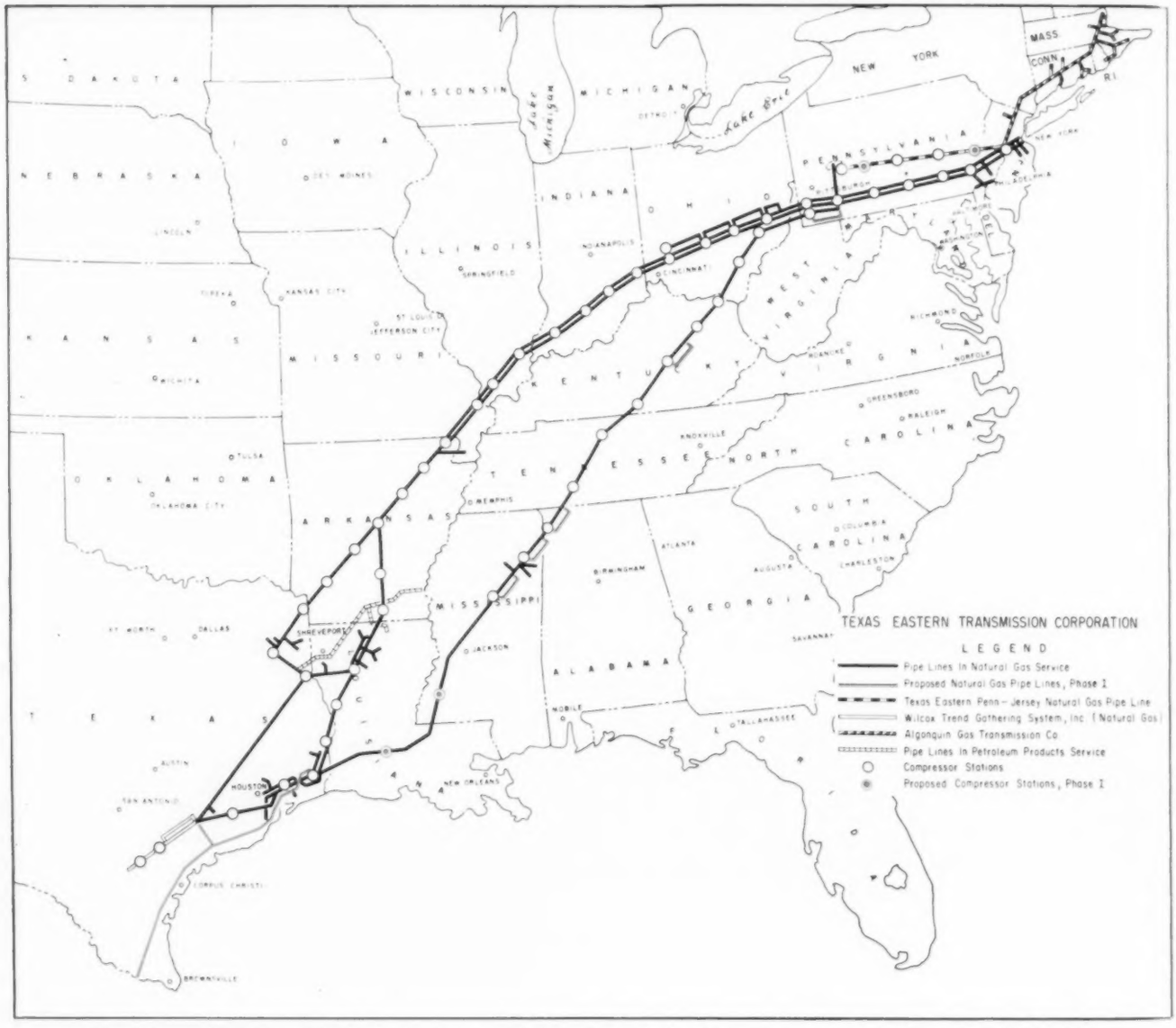
TEXAS EASTERN TRANSMISSION CORPORATION
LEGEND
Pipe Lines In Natural Gas Service
Proposed Natural Gas Pipe Lines, Phase I
Texas Eastern Penn-Jersey Natural Gas Pipe Line
Wilcox Trend Gathering System, Inc. (Natural Gas)
Algonquin Gas Transmission Co.
Pipe Lines In Petroleum Products Service
Compressor Stations
Proposed Compressor Stations, Phase I

Federal Power Commission authorization has been granted for proposed pipe lines and compressor stations costing $82.7 million.

Texas Eastern Expansion Project To Transport Mexican Gas Approved

Texas Eastern Transmission Corporation's $82.7 million proposed expansion project to bring natural gas from Mexico into the U. S. has received Federal Power Commission authorization. A second phase of the expansion plan, relating to reconversion of a major segment of the Little Big Inch line to petroleum products service is yet to be approved. If the second phase is approved, the entire expansion plan will amount to an expenditure of $147 million.

The firm applied last December for authorization to build a new pipe line from Beaumont, Texas, to the vicinity of McAllen, Texas, near the Mexican border. (See PIPE LINE INDUSTRY, January, 1956, page 70).

This 30-inch line will connect Texas Eastern's 5700-mile pipe line network with a line being built by Petroleum Mexicanos to the international border. Construction is to begin immediately.

The approved project includes construction of 422 miles of 30-inch pipe from McAllen to Texas Eastern's Vidor, Texas, compressor station; 15 miles of 24-inch pipe connecting the firm's existing line near Provident City, Texas, to the new line; loops totaling 77 miles at various locations along the existing 30-inch system; 117 miles of supply and sales laterals; new and additional compression facilities totaling 32,250 horsepower; and approximately 20 sales measuring and regulating stations. The project is expected to be completed by fall of 1957.

The FPC also authorized Texas Eastern Penn-Jersey Transmission Corporation, wholly-owned subsidiary of Texas Eastern, to construct and lease to the parent company new and

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additional compression facilities totaling about 33,300 horsepower.

Completion of the authorized portion of the project will increase capacity of the company's natural gas transmission system by approximately 250 million cubic feet per day. Mexican gas will be available at the rate of 115 million cubic feet daily initially with the contract providing for this volume to be increased up to 200 million cubic feet per day as additional reserves in the fields covered by the contract are developed.

Hearings were to start October 29 on the company's proposal to remove a 1168-mile segment of the Little Big Inch line from natural gas service and convert it to a common carrier of petroleum products. Before removing it from service, Texas Eastern would build additional facilities to maintain gas service at current levels. The company proposes to offer petroleum products common carrier service along the route of the Little Big Inch between Beaumont, Texas, and Moundsville, W. Va., and to build lateral lines to other points.

New RUBEROID PIPELINE SHIELD

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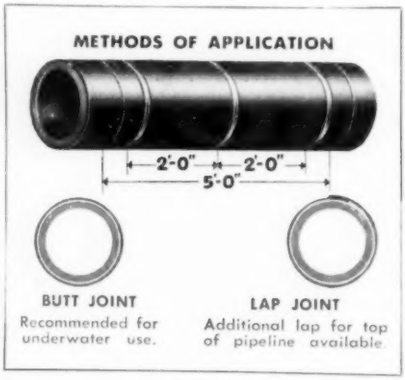
Pipeline Shield is made of two or three-ply premium felt impregnated with bitumen. It's extra tough and durable to withstand extremes of abrasion and penetration . . . to keep lines operating without costly interruptions for repair.

Pipeline Shield is easy to apply right over the felt outer covering. Available in 5' lengths . . . in widths from 12" to 116" to fit any size pipe. One or two man crews can quickly install it with 1" metal strapping. Seals (660 per 1000') are just as simple to install.

When laying pipelines through rocky areas or underwater, give them that extra margin of safety with Ruberoid Pipeline Shield. It will mean extra years of trouble-free performance in those extra tough areas.



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Contracts Let for Projects In South Dakota and Canada

Contracts have been let recently fo pipe line construction projects fo Northern Natural Gas Company an Mid Western Industrial Gas, Ltd.

R. H. Fulton & Co. will build a 164-mile extension of Northern Natural's pipe line system from Sioux Falls to Aberdeen, S. D. The extension includes about 12 miles of 16-inch, 83 miles of 12-inch and 71 miles of 10-inch. Troth Construction will build 161 miles of branch lines in South Dakota, and Underground Constructors, Inc., has been awarded the contract for several miles in Iowa.

Fulton Banister, Ltd., will construct a 6-inch gas line for Mid Western Industrial Gas from the new gas plant at Redwater, Alberta, to the nickel plant at Fort Saskatchewan. This 18-mile line includes a crossing of the North Saskatchewan River.

Gulf Interstate to Build $9 Million Gas Project

The Federal Power Commission has granted temporary authorization to Gulf Interstate Gas Company to build natural gas facilities in Louisiana, Mississippi, Tennessee and Kentucky estimated to cost $9 million.

Facilities include a 2000 horsepower addition to the Acadia, La., compressor station; a 3500 horsepower addition to the Stanton, Ky., station; construction of 3500 horsepower stations at Rapides, La., Humphrey and Alcorn, Miss., and Macon, Tenn; and miscellaneous small gathering lines and measuring stations to connect new supplies of gas contracted for by United Fuel Gas Company in south Louisiana.

Dutton Williams to Lay Gas Line in Br. Columbia

Dutton Williams Brothers, Ltd., has been awarded a contract to construct approximately 350 miles of main line and several hundred miles of distribution lines for Inland Natural Gas Company in British Columbia.

The project includes 4 to 12-inch trunk lines from Savona through Kamloops, down the Okanagan Valley to Oliver and east to Nelson, and distribution lines serving more than 25 communities along the route. Inland will draw its gas from the line now under construction by Westcoast Transmission Co., Ltd.

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Agent for T. D. Williamson, Inc.

***In Cooperation with T. D. Williamson, Inc.*

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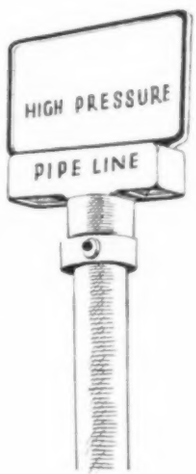

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Working in cooperation with engineering departments, Topaz sales engineers perform flow condition analyses, pigging, stopple application, inspection and line testing. All equipment for these operations may be leased, contracted or purchased through Topaz.

Cathodic Protection

All cathodic protection equipment and supplies, including rectifiers, anodes, coke breeze, pipe wrap and pipe coatings are available from one supplier . . . Topaz . This means savings to you in time and paper work.

Other supplies available from Topaz:

- valves
- pipe cutting machines
- cutting and beveling machines
- odorizers
- clamps, hooks and dollies
- pipe saddles and reducers
- heavy machines
- torches
- Plus all other equipment or supplies necessary to complete your project.

Tod Pazdral *Pipeline Specialties*

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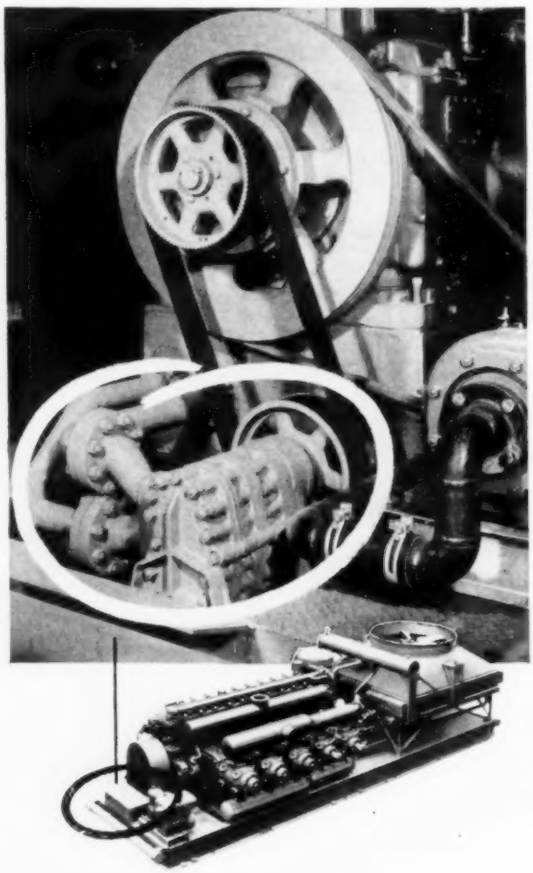
196

COST CUTTING CASE STUDY

BERRY® Hydraulic Drives . . .

Standard on Clark Compressors

TAKE A TIP FROM CLARK



Berry drives give:

- COOL WEATHER ECONOMY
- PRECISION TEMPERATURE CONTROL
- INFINITELY VARIABLE FAN SPEED
- FLEXIBLE FAN LOCATION
- LOWER MAINTENANCE COST
- SIMPLIFIED POWER TRANSMISSION

These are the reasons Clark Bros., Inc. standardized on Berry Hydraulic Drives to run the direct mounted radiator fans on their portable, skidmounted HMA-B Compressors. They replace conventional belt drive and jack shaft. Clark finds that versatile Berry Drives give them greater latitude in locating the radiator fan. Their customers like the infinitely variable fan speed that can be changed to fit the cooling requirement. Since input horsepower is only that necessary to operate the fan under any given temperature condition, there is a saving in power during cooler weather. Proved too, are lower upkeep costs and longer component life resulting from the cushioning effect of fluid power.

What does this mean to You?

The advantages of Berry Hydraulic Drives can be translated into lower costs on *your* power transfer requirements. Economical and easy to install, Berry Hydraulic Pump/Motor Drives assure smooth, sure, foolproof power at infinitely variable speeds. They are quiet running with maximum power efficiency. And, you can depend on Berry Hydraulic Pump/Motor Drives!

Send for this catalog now!

It's packed with simplified cutaways and data that tell you the "why" and "how" of Berry Hydraulic Drives.

BERRY DIVISION

OLIVER IRON AND STEEL CORPORATION

PITTSBURGH 19, PA.

BB-8

PG&E Plans 200-Mile Gas Line in California

Pacific Gas & Electric Company has announced plans for the construction in 1957 of a 200-mile, 12-inch natural gas transmission line from northern California gas fields into Humboldt County, Calif.

Capacity of the new line will be 2[illegible] million cubic feet daily, nearly four times the daily deliveries presently available from the local Tompkins Hill field. The $9.5 million transmission line will take gas from the Beehive Bend, Perkins Lake and Corning fields, in Glenn and Tehama counties. The line will extend northerly to Red Bluff, westerly across the valley and mountains to Fortuna, Eureka and Arcata on the coast.

Current construction underway by PG&E includes a $588,000 project including facilities to bring gas from the San Ardo oil field into the area from King City north as far as Salinas, Monterey and Fort Ord. An agreement with The Texas Company provides for delivery of 17 million cubic feet of San Ardo gas daily into the PG&E system.

The San Ardo project, under contract to M.G.M. Construction Company, includes approximately 30 miles of from 3 to 12-inch pipe and additional metering and pressure regulating facilities. Construction is expected to be completed in November.

Fluor Maintenance, Inc., will build additional compressor station facilities for PG&E at Kettleman Hills, Hinkley and Needles, Calif. Scheduled for completion this year, the project is estimated to cost in excess of $500,000.

Manufacturers Light Gets OK for Gas Facilities

The Manufacturers Light and Heat Company has received authorization from the Federal Power Commission to operate existing, leased and proposed natural gas facilities in Pennsylvania.

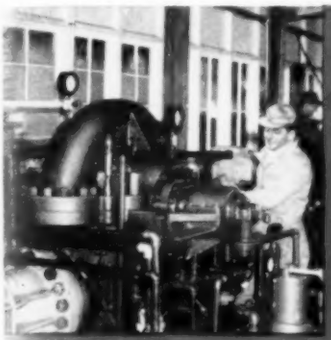
The application of Trans-Penn Transit Corporation to operate 109 miles of pipe line in Pennsylvania and a leased compressor station at Emporium, Penn., was dismissed. These facilities will now be leased to and operated by Manufacturers.

The firm will continue operation of its Clinton County line and its existing 2640 horsepower Renovo compressor station, and will construct a new

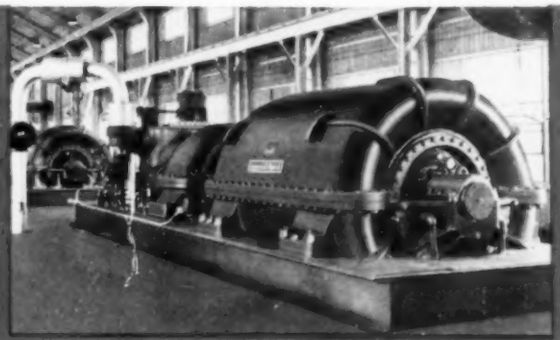
more than 325,000 horsepower of

CENTRIFUGAL COMPRESSORS

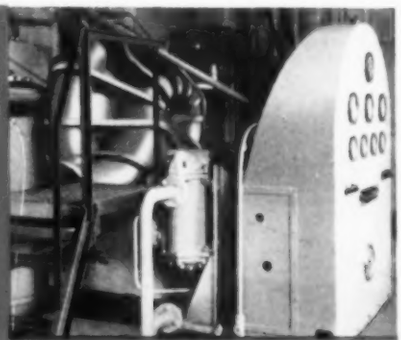
for NATURAL GAS SERVICE



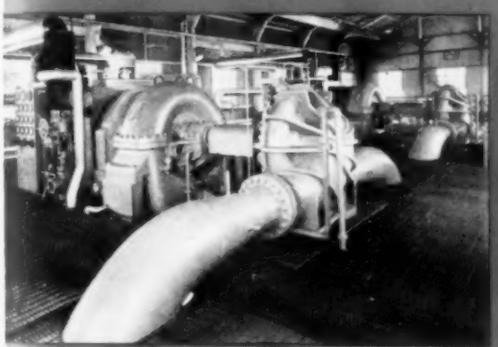
I-R centrifugal pipe-line compressor — 1250 hp, 3600 rpm, 750 psig discharge pressure.



Two 4,200 hp I-R centrifugal compressors, each handling 38,600 cfm of casing-head gas at 9.74 psig intake and 36.8 psig discharge.

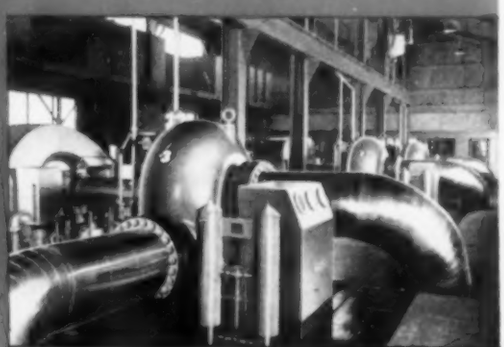


I-R centrifugal compressor boosting natural gas from 613 to 683 psig in pipe-line service.



Steam-turbine-driven I-R centrifugal gas compressors — 470 to 800 psig in 3 stages.

Ten I-R centrifugal compressors, boosting natural gas to 2,000 psig in 7 stages of compression for repressuring service.



Three of 8 I-R centrifugal pipe-line compressors with gas-turbine drive — 5000 HP, 800 psig discharge.

This experience means
LONG-RANGE SAVINGS
in modern pipe-line service

FROM THE VERY first pipe-line installation, Ingersoll-Rand has pioneered in the development of centrifugal gas compressors for higher and higher capacities and pressures. Every step of the way, dependability of performance has been a prime consideration in every detail of design and construction. This is why more I-R centrifugal compressors have been sold for natural gas service than any other make — a total exceeding 325,000 hp for this service alone. Backed by such long and successful experience, the modern I-R centrifugal gas compressor is your best assurance of trouble-free performance and long-range economy.

Ask your I-R representative for the complete, cost-saving story on centrifugal compressors for every service.

I-R "FIRSTS" in Centrifugal Gas Compressor History

FIRST **Centrifugal Pipe-Line Compressor**

FIRST **Gas Turbine Driven Centrifugal Pipe-Line Compressors**

FIRST **2,000 psi Centrifugal Gas Compressor**

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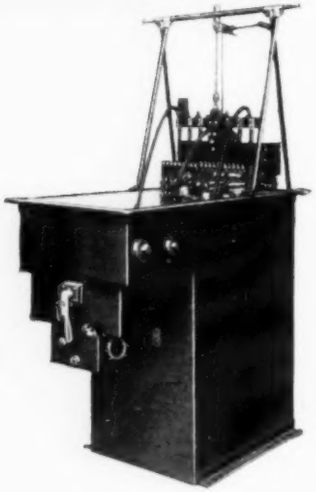
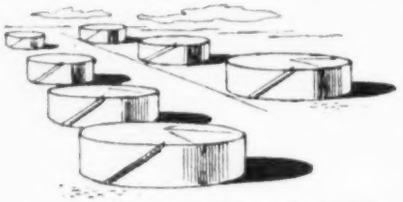
TOTALLY OIL IMMERSED
50,000 KVA
interrupting capacity
MOTOR STARTERS
have many advantages





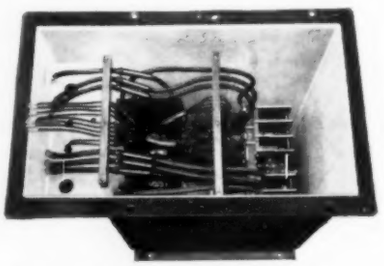
These starters are designed specifically for Division 2, semi-hazardous locations. They are low in first cost and are easy to service when inspection or maintenance are necessary. They require little floor space.

High interrupting capacity is inherent . . 50,000 KVA and no power fuses required. The well-known Type ZHS Magnetic Contactor has been certified for this rating. It is of heavy-duty construction to assure trouble-free operation.

Before buying 2300-5000 volt motor starters, investigate EC&M Type ZHS Starters. They provide economy in installation, operation and maintenance, and are available in a range of horsepower sizes.

Write for Bulletin 1062-20.

Contactor and Relay Panel are bolted together for raising as a unit above the oil. No leads or bolts to disconnect. Shown is Cat. No. 2645A Lifting Mechanism, available at small cost.



Looking down into starter showing anti-syphon lead construction from contactor, control transformer and overload relay panel to conduit connection box with threaded couplings. Starter with oil disconnect switch shown in views above.

6834

SQUARE D COMPANY
EC&M DIVISION • CLEVELAND 28, OHIO

compressor station known as the Delmont station near Jeanette, Penn., with a 1760 horsepower rating; and various taps and measuring and regulating stations.

Hope Natural Gas Receives Compressor Station OK

Hope Natural Gas Company has been authorized by the Federal Power Commission to construct and operate a $2.1 million 5400 horsepower compressor station in the Fink storage field in West Virginia.

Proposed facilities will enable Hope to cycle an additional 10 billion cubic feet of gas annually. They will also enable the company to increase its deliveries to 160 million cubic feet daily while maintaining a storage inventory of 26 billion cubic feet.

Texas Gas Proposes Gas Line And Facilities in Louisiana

Texas Gas Transmission Corporation has applied to the Federal Power Commission to construct and operate natural gas facilities in Louisiana costing $1.5 million.

The company proposes to build 13 miles of 20-inch line from the end of its East Lake Palourde 20-inch line in Assumption Parish to the Thibodaux area, Lafourche Parish, with a gas purchase meter station in the Thibodaux area.

FPC Authorizes 52 Miles Of Pipe Line in Illinois

Texas Illinois Natural Gas Pipeline Company and Chicago District Pipeline Company have received authorization from the Federal Power Commission to construct and operate natural gas facilities estimated to cost $11 million.

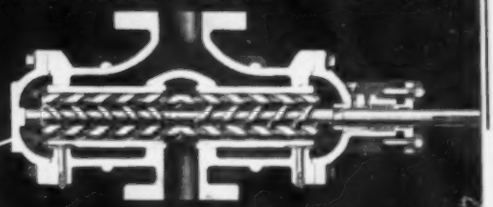
Texas Illinois will construct a 38-mile 30-inch loop line from Joliet, Ill., to connect with facilities of Chicago district in the Chicago area. Construction costs will be $6.4 million.

Chicago district will build 14 miles of 36-inch line from the eastern terminus of its Howard Street pipe line to the northerly city limits of Chicago, where it will make an additional connection with Peoples Gas Light & Coke Company and Northern Illinois Gas Company. Estimated cost is $4.6 million.

DE LAVAL
HYDRAULIC FAN DRIVES

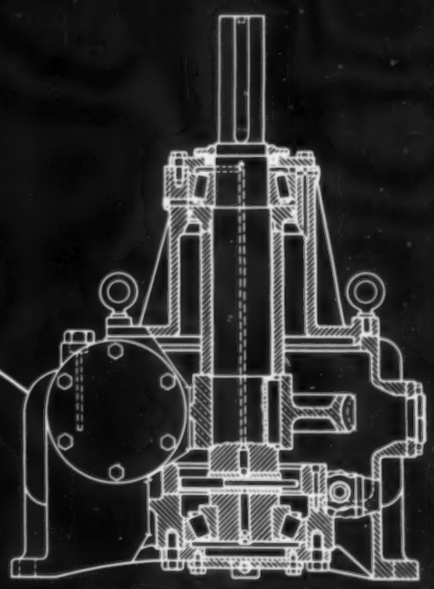
do dependable, power-saving job in air-cooled cooling towers

De Laval IMO Motors and Pumps



simple, reliable, pulsation-free

De Laval Worm Gear Speed Reducers



ruggedly built for severe service

De Laval IMO Motors and Worm Gear Reducers in a Southwest air cooled heat exchanger installation.

De Laval Hydraulic Fan Drives for air cooled heat exchangers and cooling towers *save power* since the fan operates at full speed only a portion of the time. Furthermore, there is no demand charge on hydraulic power. • Equally important, they provide *accurate, automatic* control of engine jacket water temperature, and also assure *complete operational flexibility*. Due to the simplicity of De Laval IMO motors and pumps as well as the rugged construction of De Laval Worm Gear Reducers, these units stay on the job for years. Both IMO motor and speed reducer are mounted and factory aligned on a single bedplate.

Investigate *all* the advantages of De Laval Hydraulic Fan Drives. Send for your copy of Bulletin 3009 which includes helpful performance data.

DE LAVAL *Hydraulic Fan Drives*

DE LAVAL STEAM TURBINE COMPANY

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DL370

A Tight Spread in Operation

American Louisiana Pipe Line Company's 122-mile 22-inch lateral line is the longest large diameter pipe line yet to be wrapped with polyethylene tape for corrosion protection. Peat bog hazards are minimized with a tight spread and a minimum of heavy equipment on this Houston Contracting Company spread. Connecting the American Louisiana main line near Defiance, Mich., with the Michigan-Wisconsin pipe line near Bridgman, Mich., this natural gas line is being constructed by Houston Contracting and H. C. Price Co.

California Four Corners Crude Line Planned

Two major California oil companies, Shell Oil Company and Standard Oil Company of California, are studying plans to build a 600-mile crude oil pipe line to the Los Angeles area from the fast growing oil reserves in the Four Corners area, where the boundaries of Utah, Arizona, New Mexico and Colorado intersect.

The proposed 14-inch line would provide a market outlet for Four Corners area producers as well as a long term crude supply for California refiners.

Presidents of the two oil companies have stated that such a line would follow generally uninhabited desert country, running southwesterly from Four Corners, north of Flagstaff, Ariz., and through the Mojave desert.

Although engineering plans are still tentative, the line is expected to have an initial capacity of 50,000 barrels daily and an ultimate capacity of approximately 100,000 barrels through addition of more pumping stations.

Proposed Pipe Line Construction

COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
Alberta Gas Trunk Line Ltd.	547	6-34	Gas	From Alberta fields to western terminus of Trans Canada Pipe Line, Ltd.	$47 million	Approved
Andes Pipeline Corp.	500	12	Gas	From Villamontes, Bolivia, across Andes to Antofagasta, Chile	$30 million	Planned
Bolivian Gulf Oil Co.	201	8-10	Crude	Sicasica, Bolivia to Arica, Chile	$10.5 million	Planned
British Petroleum Company	....	16	Crude	Popton Point, South Wales, to Llandarcy refinery	$14 million	Considered
Chaco Pipeline & Refinery Corp.	450	....	Products	From Glenn McCarthy's Bolivian wells to new refinery at Conception, Paraguay	.....	Planned
Cities Service Gas Co.	35	6, 12, 16	Gas	Facilities in Kansas, Missouri, and Oklahoma	$2.8 million	Authorized
	28	20-30	Gas	Facilities in Oklahoma	$1.4 million	Authorized
Coastal Transmission Corp.—Houston, Texas	565	20-26	Gas	McAllen, Texas—Louisiana connection, Houston, Texas Gas, plus 272 miles of laterals	$68 million	Before FPC
Colorado Interstate Gas Co., Colorado Springs, Colo.	734	22-34	Gas	Texas & Oklahoma Panhandle to Kit Carson, Colo., to Beatrice, Neb.	$87 million	Before FPC
	36	26	Gas	East Denver to South Denver station and loop of Portland lateral	$1.3 million	Authorized
Compania Shell de Venezuela	177	20	Gas	La Paz field to Cardon refinery on Paraguana peninsula	$20 million	Planned
Consolidated Gathering Systems, Ltd.	198	....	Crude	Sturgeon Field—Edmonton.	.....	Planned
Creole Petroleum Corp.	94	28	Crude	Temblador to Caripito, Venezuela	$5.6 million	Planned
Deep Rock Gas Co.	120	6	LPG	Tioga, N.D.—Canadian border	.....	Planned
El Paso Natural Gas Co.	888	....	Gas	Facilities in Texas, New Mexico, and Arizona to deliver gas near Blythe, Calif. and Topock, Ariz. to So. Counties Gas Co., So. Calif. Gas Co. and Pacific Gas & Electric Co.	$84.5 million	Before FPC
	108	....	Gas & Products	Facilities in Andrews and Ector Counties, Texas	$5 million	Authorized
	28	10	Gas	Nolan and Coke Counties, Texas, plus compressor station facilities	$1 million	Authorized
El Paso Natural Gas Products Co.	240	8	Products	Midkiff natural gasoline plant in Permian Basin to El Paso	.....	Planned
Houston Texas Gas & Oil Co.—4604 Main St., Houston	961	12-30	Gas	Baton Rouge, La. to Miami, Fla. plus 496 miles of laterals and compressor facilities	$105 million	Before FPC
Inland Natural Gas Co.	320	6-12	Gas	To tap Westcoast Transmission's trunk line at Savona, British Colombia.	.....	Contract let
Interprovincial Pipe Line Co.	150	20	Crude	Sarnia, Ont. to Toronto, Ont.	.....	Planned
Interstate Oil Pipe Line Co.	55	8	Crude	Billings, Mont. to Wolf Springs, Mont.	.....	Considered
Iraq Petroleum Co.	50	24	Crude	Homs, Syria, to Banias, Syria	.....	Contract let
	1,200	38-40	Crude	Kuwait to Iskenderun, Turkey	.....	Considered
Iron Ranges Natural Gas Co.	115	....	Gas	From Itasca and St. Louis Counties along route of Mesabi range from Grand Rapids to Aurora, Minn.	$5 million	Before FPC
Iroquois Gas Corp.—Buffalo, N.Y.	36	....	Gas	Facilities in Chautauqua, Cattaraugus and Erie counties, N.Y. to develop new underground storage area for natural gas	$2.8 million	Authorized
Israel Government	70	6	Products	Haifa to Tel Aviv	$1 million	Planned
Kansas-Nebraska Natural Gas Co.	32	....	Gas	Facilities in Nebraska	$4 million	Authorized
	62	....	Gas	Gathering line and measuring facilities from Camerich field, Okla. to Northern Natural Gas Co.'s Liberal, Kansas, station.	$1.4 million	Before FPC
Lone Star Gas Co. Dallas	230	22-26	Gas	Cotton County, Okla. to Fritch, Texas	$18.7 million	Before FPC
Magna Pipeline Company	40	....	Gas	Underwater line from Anacortes, Wash. to Victoria, B.C.	$6 million	Planned
Mene Grande Oil Co.	62	30	Crude	Anaco to Puerto La Cruz, Venezuela	$5.8 million	Considered

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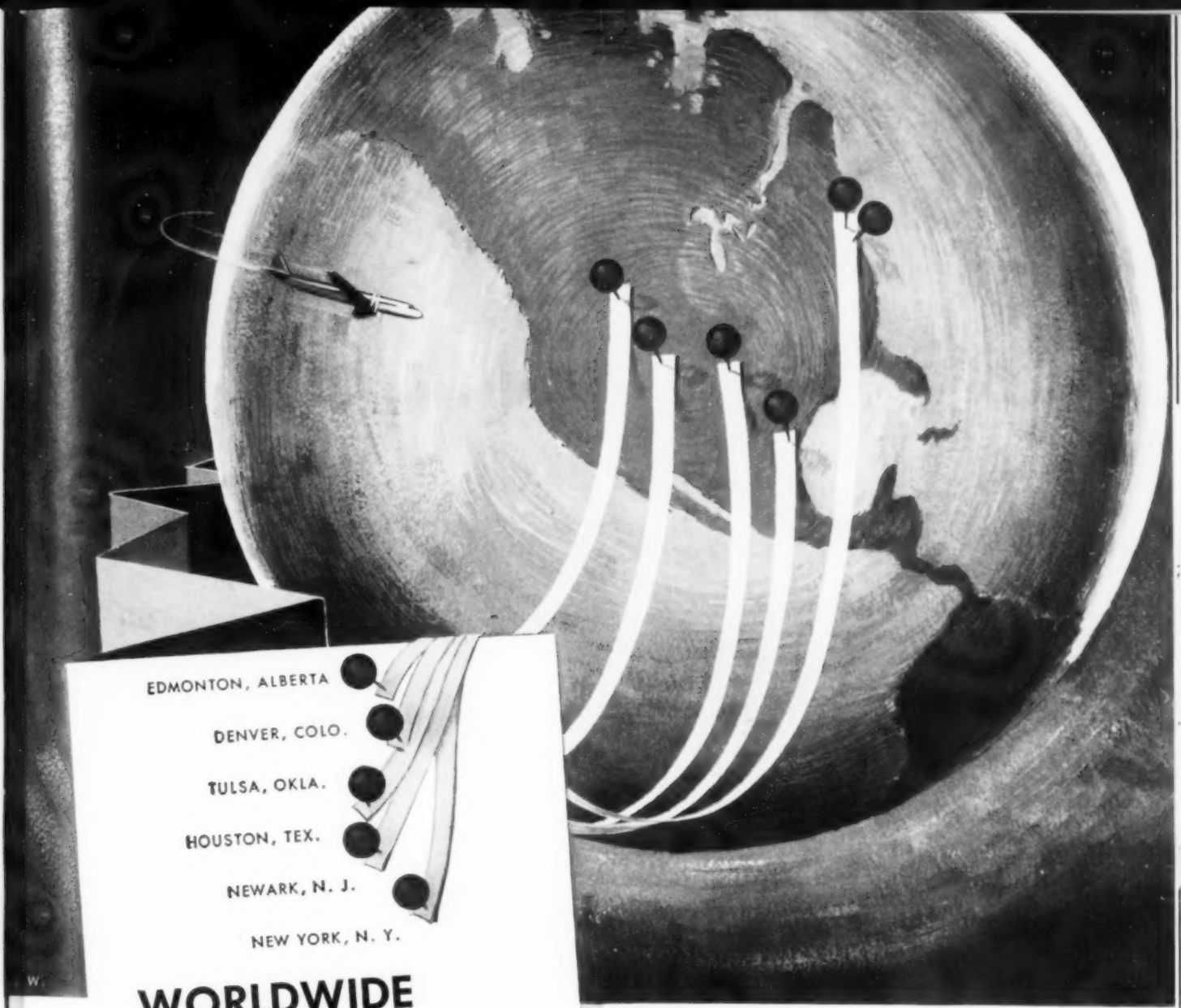

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Pipeline contractors have found that Crose equipment on the line means more efficient construction. Crose maintains strategic supply points and uses fastest transportation methods for best delivery and service to the pipeline industry everywhere.

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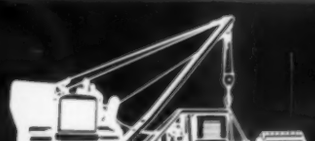
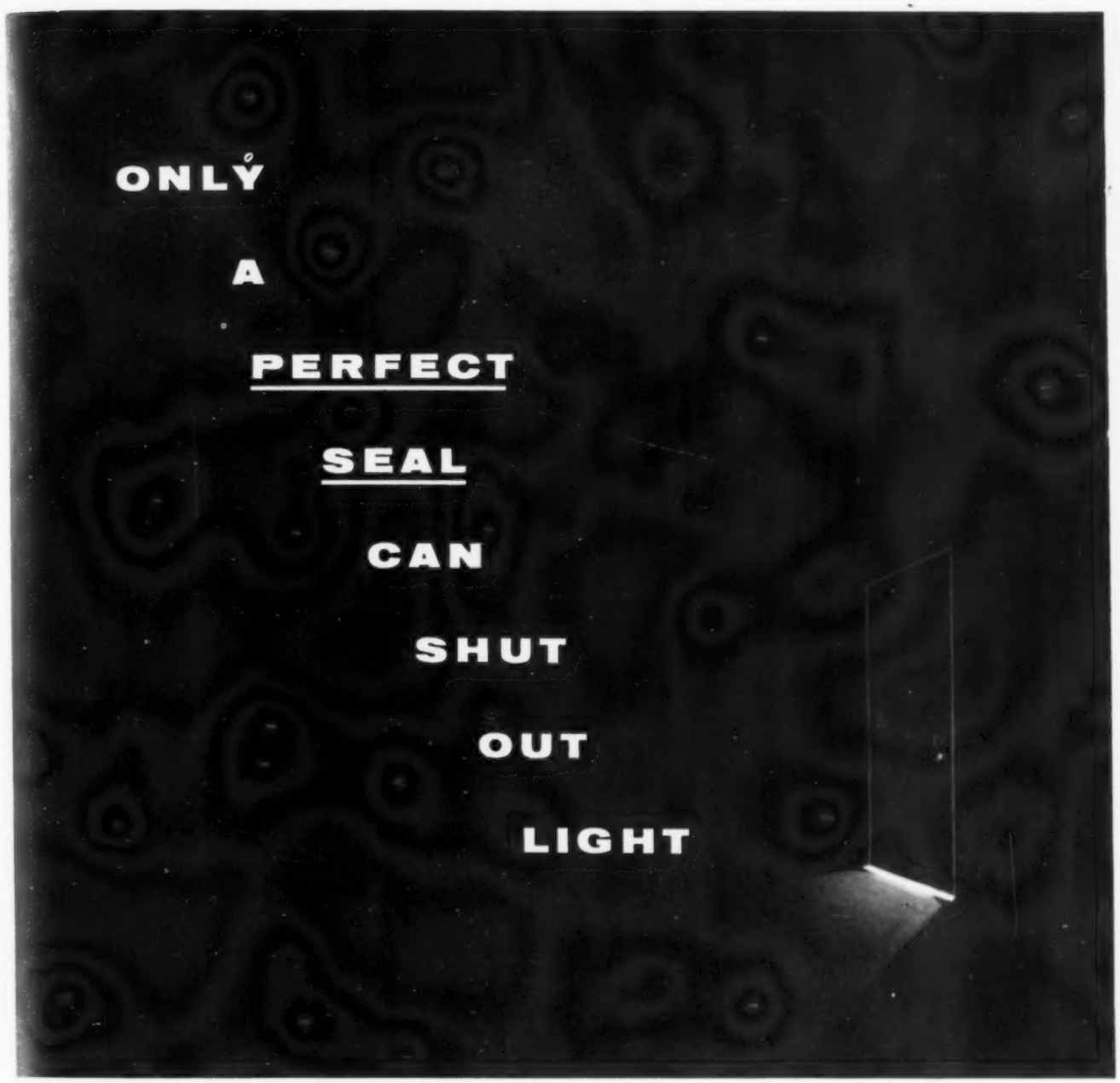
INTERNAL LINEUP CLAMPS


DITCH PADDER

CLEANING & PRIMING MACHINES

Proposed Pipe Line Construction—(Continued)

COMPANY	Length in Miles	Diameter	Type	Origin and Terminus	Estimated Cost	Status
Michigan-Wisconsin Pipe Line Co.—500 Griswold, Detroit	472	4-24	Gas	Main line loops and extensions in Wisconsin, Illinois	$17.6 million	Before FPC
	252	.....	Gas	Loops in Missouri, Iowa, Wisconsin and Illinois	.....	Contracts let for 225 miles
Midwestern Gas Transmission Co., Houston, Texas	1112		Gas	Emerson, Manitoba—Nashville, Tenn.	$98 million	Before FPC
Mountain Fuel Supply Company	38	20	Gas	Parallel line and facilities to transport gas from Pacific Northwest line in Sweetwater County, Wyo.	$3 million	Authorized
NATO	1920	4-10	Products	To serve military bases in Western Europe	.....	Foster-Wheeler Prime Contractors, 1330 miles let
Natural Gas Pipe Line Co. of America—20 N. Wacker Dr., Chicago	370	20, 26	Gas	Wise County, Texas—Fritch, Texas	$28.5 million	Before FPC
	25	.....	Gas	Quinduno field in Roberts County, Texas	$3.2 million	Authorized
	416	36	Gas	Loops at various points along existing line	$76.2 million	Before FPC
New York State Natural Gas Corp.	27	.....	Gas	Elk County, Penn. to Luthersburg gas field in Clearfield, Jefferson and Indiana Counties, Penn.	$1.5 million.	Authorized
North Carolina Natural Gas Corp.	575	3-16	Gas	Mooresville eastwardly across North Carolina	$13 million	Authorized
Northern Natural Gas Co.—2223 Dodge St., Omaha	167	24	Gas	Farmington, Minn. to Duluth, Minn. and Superior, Wis	$12 million	Before FPC
	42	10	Gas	Rochester, Minn. to Winona and Goodview, Minn.	$963,000	Before FPC
	163	.....	Gas	Extension of system from Sioux Falls, S.D. to Aberdeen, S.D., plus 160 miles of branch line	.....	Contracts let
Northwest Pipeline Corp.	350	6-10	Crude & Products	Four Corners area to Salt Lake City, Utah	$15 million	Planned
Offshore Gathering Corp., Houston	364	24, 26, 30	Gas, Crude	Texas side of Sabine River 25 miles offshore La. to Mississippi side of Pearl River	$150 million	Planned
Ohio Fuel Gas Co., Columbus	19	6-16	Gas	Loops on existing line to serve Dayton and Toledo areas and extension to McCutchenville, Ohio	$772,300	Before FPC
Pacific Gas & Electric Co.	150	34	Gas	Various loops, between Topock, Ariz.—Milpitas, Calif.	$20 million	85 miles let
	83	12, 18, 20	Gas	Glenn County area to Sacramento region	$5 million	Planned
	200	12	Gas	Northern California gas fields to Humboldt County, California	$9.5 million	Planned
Pacific Northwest Pipe Line Corp.—Salt Lake City, Utah	50	4-6	Gas	To serve industrial customers at Uravan and Nucla, Colo.	$1 million	Authorized
Pembina Pipe Line, Ltd.	100	.....	Crude	Gathering line and new pumping unit in West-Central Alberta	$4.5 million	Planned
Pennsylvania Gas Co.	38	8, 10	Gas	In Erie and Warren Counties, Penn., and Chautauqua County, N.Y.	$930,000	Before FPC
Petroargentina	370	16	Crude	Newguen—Bahia Blanca, Argentina	$40 million	Planned
Petroleos Mexicanos—Ave. Juarez, 94, Mexico City	440	20	Gas	Brazil—Tampico—Poza Rica, Mexico	.....	Planned
	145	12	Crude	18 de Marzo Field—Monterrey, Mexico	.....	Considered
	80	8	Products	Guaymas—Los Mochis	$1 million	Planned
Piedmont Gas Co.—Hickory, N.C.	78	2-8	Gas	From connection with Transcontinental Gas Pipe Line to serve customers in North Carolina	$2.6 million	Before FPC
Royal Dutch Shell	700	30	Crude	Mediterranean Sea to North Sea ports	$280 million	Considered
Saskatchewan Power Corp.	80	.....	Gas	Hatton gas field to Success, Sask.	.....	Planned
	40	.....	Gas	Moose Jaw, Sask. to Regina, Sask.	.....	Planned
Scranton-Spring Brook Water Service Co.	37	12	Gas	Hebron-Greenwich facilities of Tennessee to Scranton and Wilkes-Barre, Pa.	$1.6 million	Before FPC
Service Pipe Line Corp., Continental Pipe Line Co., Sinclair Pipe Line Co. and Phillips Petroleum Co.			Products	Salt Lake City to Spokane, Wash.	.....	Considered
Shell Oil Company and Standard Oil Co. of California	600	14	Crude	Four Corners area to Los Angeles area	.....	Considered
Sinclair Oil—Refining Co. and Socony Mobil Oil Co.	211	.....	Crude	San Silvestre field, Barinas, Venezuela, to Puerto Cabello on Caribbean sea coast	$25 million	Planned
Sohio Petroleum Co.	37	8	Products	Mogadore to Girard, Ohio	.....	Planned
South Alberta Pipe Line, Ltd.	46	10	Gas	Etzikom Field—Medicine Hat, Alberta	$1 million	Planned
South Saskatchewan Pipe Line Company	58	12	Crude	Cantuar field to Dollard field, Saskatchewan	$3 million	Approved
Southern Natural Gas Company	52	.....	Gas	Various locations in Ga. and La.	$2.2 million	Authorized
	28	8-12	Gas	Connect 3 gas fields to east leg of south La. supply system plus compressor station additions.	$2.9 million	Authorized
Southern Pacific Pipe Lines, Inc.	300	.....	Products	From San Francisco Bay area to Reno—Fallon, Nev. area	$16 million	Approved
Stanmount Pipe Line Co.	140	10	Crude	Cayuga and Beaver Lake Fields, N.D. to connect with Interprovincial Pipe Line	.....	Planned
Sturgeon Pipe Line Ltd.	100	12		Sturgeon Lake Field—Trans-Mountain system	$6.5 million	Planned
Tecumseh Pipeline Co.	190	20	Crude	To connect to principal crude line carriers in Chicago area for movement to east	.....	Planned
Tennessee Gas Transmission Co.—Box 2511, Houston (See also Midwestern Gas Transmission Co.)	100	.....	Gas	Gathering lines in Texas and Louisiana plus station additions	$18.6 million	Before FPC
	1085	12-30	Gas	Southeast La. to Portland, Tenn.; from Kinder, La., to offshore wells in Gulf of Mexico; from Coudersport, Penn., to Hamburg, N.Y., and loop lines in Ky., W. Va., Penn.; compressor stations in Miss., Tenn., N.Y., Penn.; and additions in Tenn., Ky., Ohio, and Penn.	$166 million	Before FPC
Texas Eastern Transmission Corp., Shreveport, La.	422	30	Gas	McAllen to Vidor, Texas	Estimated Cost of Entire Project	Contract let for 121 miles
	77	30	Gas	Loops at various points between Kosciusko, Miss. and Uniontown, Penn.		Authorized
	45	24	Gas	Provident City, Texas crossover to McAllen-Vidor line	$82.7 Million	Contract let
	147			Supply and delivery lines laterals		Authorized
Texas Gas Transmission Corp.	40	6-30	Gas	Parallel lines and compressor additions on existing lines in Louisiana, Missouri, Mississippi, Illinois, Kentucky	$6 million	Authorized
	.....	.....	Gas	To deliver gas from four Louisiana gas fields to American Louisiana system.	$783,100	Authorized
	13	20	Gas	East Lake Palourde line, Assumption Parish, to Thibodeaux area, Lafourche Parish, plus metering facilities	$1.5 million	Before FPC
Texas Illinois Natural Gas Pipeline Co., Chicago	38	36	Gas	Loops facilities in Illinois	$6.4 million	Authorized
Trans-Canada Pipe Line, Ltd.—Calgary, Alberta	2250	30, 36	Gas	Alberta—Eastern Canada	$378 million	Contracts let for 4 spreads
Trans Carolina Pipeline Co.	280	8-18	Gas	Transmission line and compressor facilities plus 567 miles of laterals in tidewater areas of North and South Carolina	$21.6 million	Before FPC
Transcontinental Gas Pipe Line Corp.—3100 Travis St., Houston	.....	.....	Gas	Connecting facilities with Texas Eastern Penn-Jersey in Pennsylvania and New Jersey	$131,628	Authorized
	24.2		Gas	Gathering Lines from South Bayou Mallet, Maxie and Happytown Fields, La.	$754,000	Authorized
	12	.....	Gas	Live Oak gas field, Vermillion Parish, La. plus two meter stations	$707,000	Before FPC
Union Oil Co. of Calif.—Los Angeles, Calif.	225	12, 16	Crude & Products	San Joaquin Valley to Union Oil's Oleum refinery on San Francisco Bay.	.....	Planned
United Fuel Gas Co., Charleston, W.Va.	18	12	Gas	Coco compressor station in Kanawha County, W. Va., to Belle, W. Va.	$845,853	Authorized
United Natural Gas Co.	50	12	Gas	Elk County—Jefferson County, Pa.	.....	Planned
U. S. Navy	450	8	Gas	Gubik Field—Fairbanks, Alaska	$20 million	Planned
Washington Gas Light Co.—Washington, D.C.	28	20, 24	Gas	From metering station of Atlantic Seaboard Corp. to Washington to connect with line leading to District of Columbia facilities	$3.4 million	Authorized
Westcoast Transmission Company, Ltd., Calgary	270	8-26	Gas	Various locations in Peace River region	.....	Contracts let for 15 miles
Wilcox Trend Gathering System, Inc.	16	16	Gas	Gathering lines to Provident City, Texas	$2.9 million	Before FPC
Winnipeg and Central Gas Co.	450	4-8	LPG	Tioga, N.D.—Winnipeg, Canada	$20 million	Planned
Yacimientos Petroliferos Fiscales	808	.....	Gas	Campo Duran, to Buenas Aires, Argentina	$76 million	Planned
	635	.....	Crude	Campo Duran to San Lorenzo, Argentina	$24 million	Contract let
	621	.....	Crude	Mendoza to San Lorenzo, Argentina	$19 million	Planned
Yacimientos Petroliferos Fiscales Bolivia	86		Crude	Yacuiba to Bermejo, Bolivia	$3 million	Considered



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In big-bore engines, "light-tight" piston rings have revolutionized standards of performance. As a result of Pedrick pioneering, engine operators and engine manufacturers now know that all piston rings must be really "light-tight" in the cylinder if they are to deliver uniformly good performance and long life.

A "light-tight" ring is one which is made with so much care and know-how that when it is placed in a gage of cylinder size with an intense light below, no *light* leaks past the face of the ring and the cylinder wall! This means a *perfect seal*, and that's what you need in a piston ring.

PEDRICK makes "light-tight" piston rings for big-bore engines . . . the result of an uncompromising standard of quality and precision workmanship which Pedrick artisans have maintained for more than 35 years.

So, whatever your requirements . . . single rings or Engineered Sets . . . for the BEST and MOST DEPENDABLE and LONGEST ring performance between engine overhauls, it will pay you to insist on PEDRICK light-tight, quick-sealing rings. Engineering service available also to help you with special problems. Write, wire or phone: WILKENING MANUFACTURING CO., Philadelphia 42. Saratoga 9-3770.

Pedrick PISTON RINGS

PEDRICK PRECISIONEERING KEEPS PEDRICK FIRST

Toughest pipeline i

whipped v

International C

Mud-matching traction, resulting from correct power-weight balance, enables the Superior Pipe-Boom-equipped TD-18 to string pipe through boggy swales without delay. New non-slip jaw-type drum clutches provide positive boom-load control.

An International TD-18 equipped with Superior Pipe-Boom is lowering-in a section of welded 26-inch line for final tie-in. Equipment at work near Chehalis, Washington, on section 16 spread of Midwestern Constructors, Tulsa, Okla.

Contractors on the job between Chehalis, Washington and Umatilla, Oregon:

Midwestern Constructors, Inc., Tulsa, Oklahoma

River Construction Co., Fort Worth, Texas

Engineers Limited Pipeline Co., White Salmon, Washington

in U.S.A.

with

Crawlers

Veteran pipeliners on the New Mexico-Canada gasser sections between Chehalis, Washington, and Umatilla, Oregon agree: It's the roughest and toughest, ever! And they'd laid pipe in swamps and sandhills—through woods and over mountains!

Here, they had to bee-line through big timber up 55% mountain grades—cross a 16 mph river—overcome run-off mud from a record snow-pack.

They required big TD-24 "muscle" and exclusive Planet Power steering—with full *live power* on both tracks—for positive control under hazardous conditions. They demanded TD-18 safety and extra capacity—with quick pick-up, full-power traction, and handling ease not available elsewhere! That's why one spread used 19 big International crawlers.

See your International Construction Equipment Distributor and prove this *tough job* power!

"Elevator" power for welding crews—one of these two Carco Winch-equipped TD-18's holds or lowers the welding "wagons"—the other helps the boom tractor on the 55% grades, to position pipe for welding.

Bending and handling pipe, to and from this bender is all International powered—a U-9 power unit on the Crutcher, Rolfe & Cummings bender—a TD-18, equipped with 70,000 lb. capacity Superior Pipe-Boom speeding the job!

TD-24's—the big crawlers preferred by mountain loggers, as well as pipe-liners, worked all over the spread—clearing land, logging heavily-timbered right-of-way—winching heavy equipment upgrade—dozing "walk-ways" for backhoes. Ease of control made the giant TD-24 the choice of operators and crewmen in danger spots!

Up 55% grades, trench-digging backhoes went to work—with the aid of Carco Winch-equipped TD-24's. Tractor anchors machine to "buck" out boulders—winches it upgrade as work progresses! One of many sideline jobs for the "winch-up" tractors is yanking boulders from the right-of-way.

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Rules of Thumb

FOR THE PIPELINER'S NOTEBOOK

$15 Per Rule of Thumb

These formulae from the pages of engineers' own notebooks yield rough, but reasonably accurate answers for design, maintenance and supply questions. The Editors will pay $15 for your pet Rule of Thumb. Send your Rule of Thumb to PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1.

Miscellaneous **—29—Useful mathematical shortcuts for quick field calculations.**

Use of Reciprocals—Since multiplying and dividing by 10 and multiples of 10 are quick and easy, the following basic operations with reciprocals can speed up field calculations greatly.

1. To multiply by 25, multiply by 100 and divide by 4.
2. To divide by 25, divide by 100 and multiply by 4.
3. To multiply by 125, multiply by 1000 and divide by 8.
4. To divide by 125, divide by 1000 and multiply by 8.
5. To multiply by 5, multiply by 10 and divide by 2.
6. To divide by 5, divide by 10 and multiply by 2.

Use of Short Division—Since long division can be such a long process, factoring the divisor where factors are fairly obvious and going through a series of short divisions often can shorten the operation.

Example: Divide 7538 by 144.

Long division:

```
      52.347
144 | 7538.000
       720
       338
       288
        500
        432
         680
         576
         1040
         1008
```

Short division:

$144 = 12 \times 12$

```
12 | 7538.000
12 | 628.166
     52.347
```

Figure Average Reading by Checking Departure from Convenient Average Reading

Instead of summing up all readings and dividing by number of readings to obtain average, assume a convenient average value and mentally add and subtract differences of readings from this value. Divide the result by number of readings, and add to or subtract from assumed average to get the actual average reading.

Example:

Regular method:

```
  95
  86
 100
  92
  74
  89
  83
  96
8 | 715
  89 3/8
```

Average departure method:

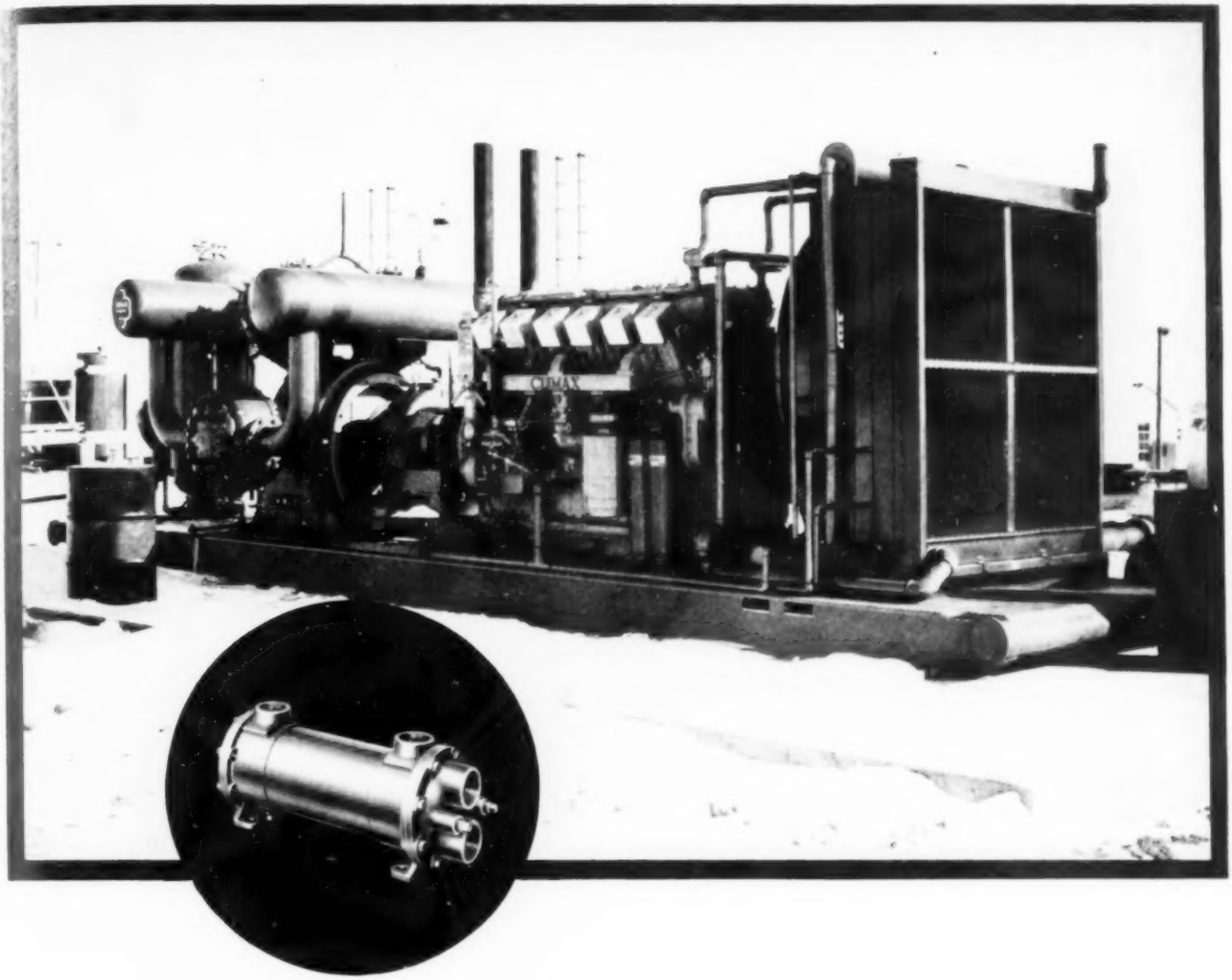
Assume average value of 90.

Difference between reading & assumed average	Summation of difference
+ 5	+ 5
— 4	+ 1
+10	+11
+ 2	+13
—16	— 3
— 1	— 4
— 7	—11
+ 6	— 5

Actual average equals

$90 + (-5/8) = 89\ 3/8$

File these shortcuts in your Rule of Thumb notebook for easy reference.



Ross Exchanger curbs rising oil temperature in this Climax Engine pipeline installation

Operating at 1030 rpm, this 12-cylinder Climax V-125 Engine drives a gas compressor (through a reduction gear) at a Colorado booster station.

To insure its stamina, a Ross Type BCF Exchanger provides safe, continuous oil cooling. Excessive friction-heat is effectively removed to protect close clearance parts from seizure.

Embodying the utmost in thermal efficiency and ruggedness, Ross Exchangers safeguard numerous types and makes of prime equipment at work on the toughest jobs in the oil and gas industry — where engines and machines are often called upon to operate continuously over extended periods.

Compact in design, Ross Exchangers are pre-engineered and fully standardized in sizes to meet a wide range of oil, water, air and gas cooling requirements. For detailed information, request Bulletin 1.1K5.

Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

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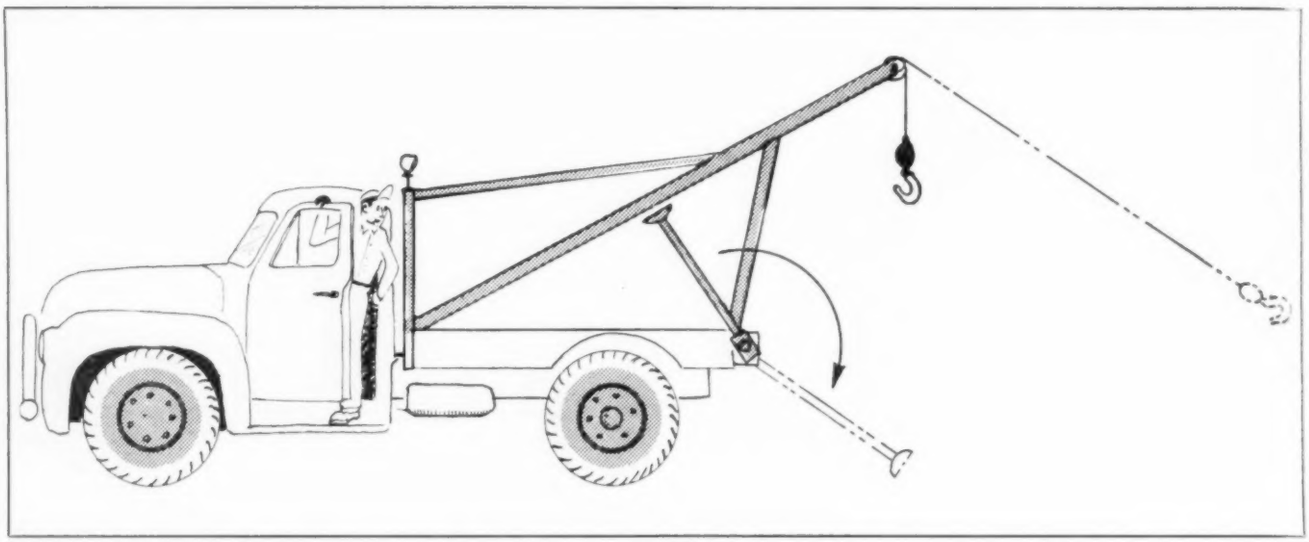


Legs Support Truck for Lifting Heavy Equipment

When it becomes necessary to lift heavy equipment around the station, these extra legs allow the winch truck to do so without danger of tipping the truck or causing it to slip.

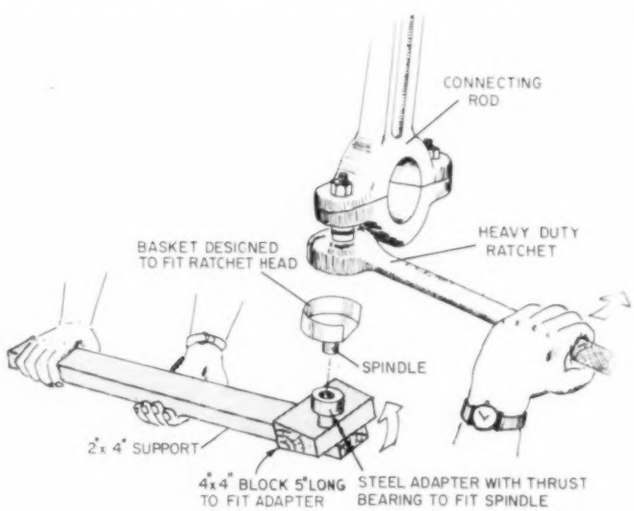
The legs are jacks which swing up under the boom on the truck bed when not in use. They can be easily dropped into position for pulling or lifting operations. The legs dig into the ground to prevent the truck from sliding back when a load is being moved or from tipping when lifting. Jacks can be adjusted to the angle shown for pulling operations or shortened and swung straight down to the ground for lifting.

Tool Holds Ratchet While Removing Connecting Rod Nuts

This support device simplifies removal of connecting rod nuts on large engines when using a heavy duty ratchet. Ordinarily a two-by-four is used to hold the large ratchet, but it is hard to keep the ratchet from slipping off.

To solve the problem, a metal basket is made from a steel strip formed to fit the ratchet head. A steel plate with a spindle attached is welded to this unit as shown. An adapter, machined from steel rod, houses a thrust bearing in one end and fits into a wooden block on the other.

The wooden block has a hole drilled into one face to mate with the steel adapter and has the opposite face beveled so that attaching a wooden support to this face will allow sufficient hand room for turning the ratchet. The support, of two-by-four construction, may be screwed or glued to the block.


CONNECTING ROD
HEAVY DUTY RATCHET
BASKET DESIGNED TO FIT RATCHET HEAD
SPINDLE
2"x 4" SUPPORT
4"x4" BLOCK 5"LONG TO FIT ADAPTER
STEEL ADAPTER WITH THRUST BEARING TO FIT SPINDLE

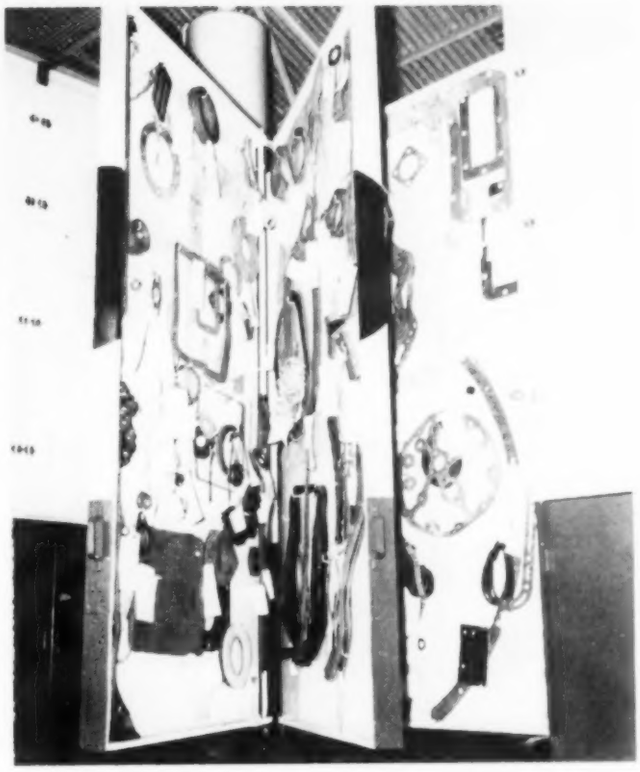
Unitized Piping Speeds Hookup of Skid-Mounted Pump

Where pumping units are needed for only a short time at various locations on a gathering line, permanent piping can be arranged as shown so that skid-mounted pumping equipment can be hooked up in a matter of moments.

Suction, discharge and fuel lines are arranged at the same relative positions so that a standard portable pumping unit can be used at all locations.

Bolt unions are used on the suction and discharge lines. A regular union is fitted to the fuel line as shown in the foreground. The bleeder line shown on the left requires no union as it is run directly from the pump unit to a sump a safe distance from the unit.

By using a similar piping set-up at the permanent pump installations, these same skid-mounted units can be used as replacement pumps if the regular pump breaks down or is in need of repair.



Hanging Gaskets on Panels Facilitates Quick Selection

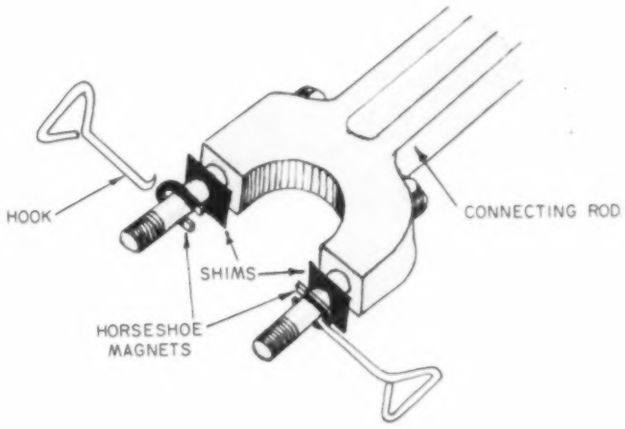
A six-foot-tall cabinet that utilizes a series of vertical panels for filing gaskets of all sizes and shapes speeds gasket selection during compressor overhaul. The cabinet has four surfaces on which to hang gaskets. It consists of a backboard that fits against the station wall, and two panels that can be swung outward on vertical hinges.

The two panels and backboard are of plywood construction with one-by-six-inch borders. The center panel is centered on the six-inch border, while the outside panels fit to the outside edges of their borders, giving maximum depth to the cabinet. This permits hanging gaskets several inches deep on the panels.

Magnet Holds Shims in Place While Installing Bearing Caps

If you've had difficulty keeping shims in place when installing bearing caps, here's an answer to your problem. On large engines where shims are used for connecting-rod bearing clearance, a small horseshoe magnet can be used effectively to hold the shims in place while removing or installing the caps.

The magnet should be thin and just large enough to fit around the connecting-rod bolt, and should have a hook or some kind of grip attached for pulling it off the bolt after the bearing cap has been tightened down.



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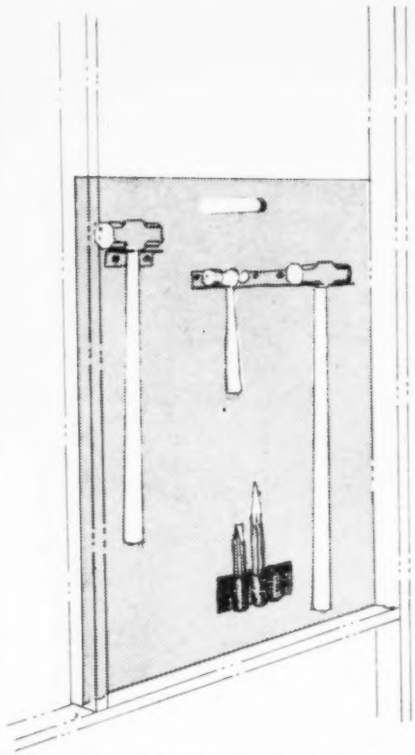
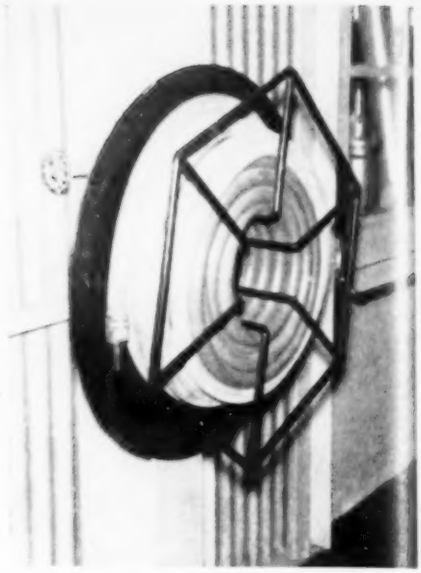


Movable Hand Tool Rack Facilitates Overhaul

A convenient hand tool rack for use around a pump or compressor station can be made of ¼ to ½-inch plate and 1½-inch pipe sections as shown. The hammer and mallet holders are bent-up sections cut to mate with the tool handles. The chisel and center-punching tool bracket is simply short sections of pipe, closed in on one end and welded to a back plate. Each of the brackets is bolted to the tool rack.

A slot is cut into the top of the rack for ease in handling when moving the tools from one engine to another. It can be set up at any convenient spot along the station walls.

Brackets can be made of brass to prevent sparking.



Install Reel on Wall For Storage of Air Hose

This reel made of ¼-inch plate and ¾-inch rod allows quick and easy winding and unwinding of air hose at convenient location around the station. The rod, made up and welded into a unit as shown, is welded to the circular back plate.

A one-inch pipe section, welded to the center of the back plate, completes the reel assembly. A ¾-inch pipe section and flange make up the support axis which is bolted to the column. A pin secures the reel on the support axis.

Scratch Pad in Panel Is Handy for Notes

One oil gager who frequently used writing pads in his truck for working up run tickets rigged a roll of adding machine paper inside the unused radio compartment of his pickup truck. After replacing the panel, he

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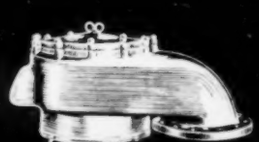
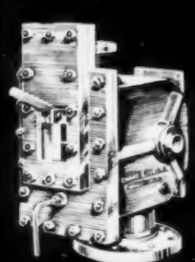
Fittings for Spheres too!

Semi-Automatic Tank Gauge and Sampling Lock, Fig. ST-9320 "DLB." Can be used for sampling and temperature thiefing. It is mounted here on S&J's Quick Opening Gate Valve, Fig. TT-135 which can be opened or closed with only half the number of turns required by other valves.

Pilot Operated Safety Relief Valve, Fig. ST-2500. Designed to protect tanks from excessive internal pressure. One pilot valve can serve one, two, or more main valves to meet high venting requirements. Main valve pallet is seated under pressure to moment of venting. This valve requires no great excess pressure for full venting capacity.



Vacuum Breather Valve, Fig. ST-1926. Designed to meet the unusual vacuum breathing requirements of pressure storage tanks, and to withstand high internal pressures when not in operation under a vacuum. This valve is automatically self draining, and utilizes a hinge type pallet.



High Pressure Automatic Tank Gauge, Fig. ST-400, will consistently and accurately measure product depths. Features new Safety Closure to protect extra thick Safety Glass. Gauge greatly reduces time required to measure tank contents accurately, because it can be installed at eye level height.

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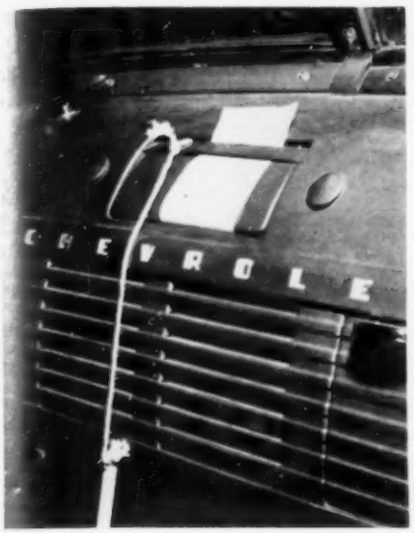


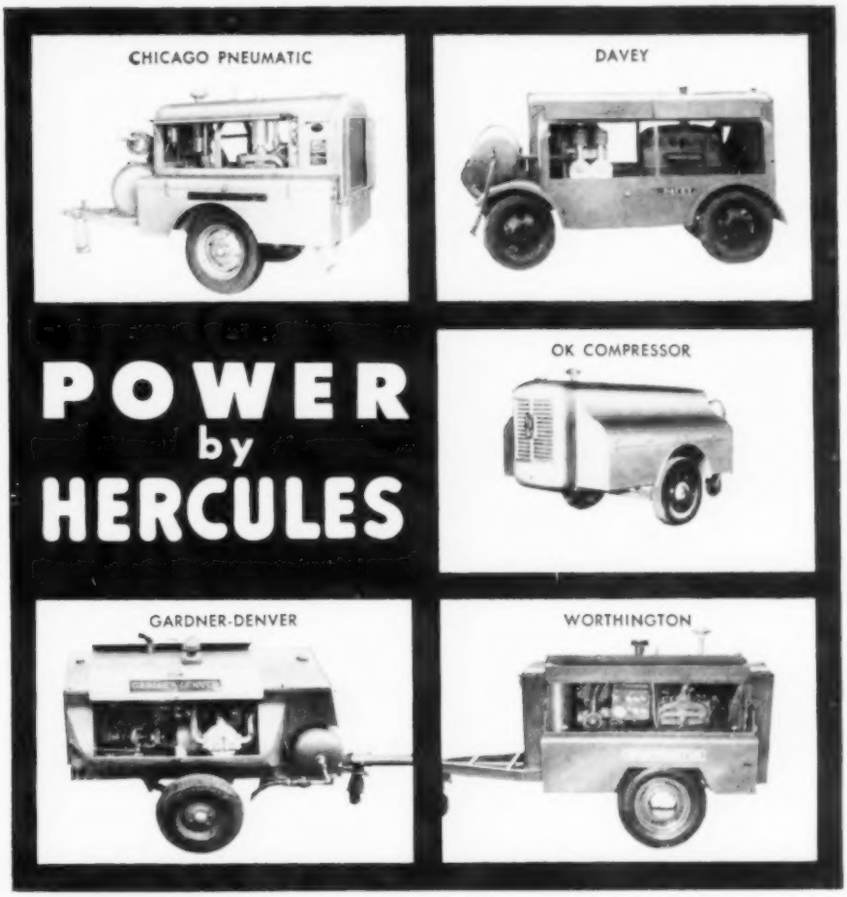
inserted a hacksaw blade across the top of it to make a cutter for the paper.

Now, it is a simple matter to make calculations and notes. These he can tear off as reminders or discard if no longer needed.

Chain Guard Rail Reduces Hazards During Overhaul

At a South Texas compressor station, a major engine overhaul once meant removing the hand rails located on the catwalk at the top of the engine in order to bring in tools and remove pistons. This left the maintenance men, who were doing the overhaul, without the safety of the rails around the platform atop the engine.

The simple operation of replacing the end rail with a removable chain solved this overhaul and safety problem. After removing the section of pipe railing, a length of chain is welded or otherwise permanently fas-



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For more data on advertised products, use Readers' Service Cards, last page

tened to one side rail as shown at the left.

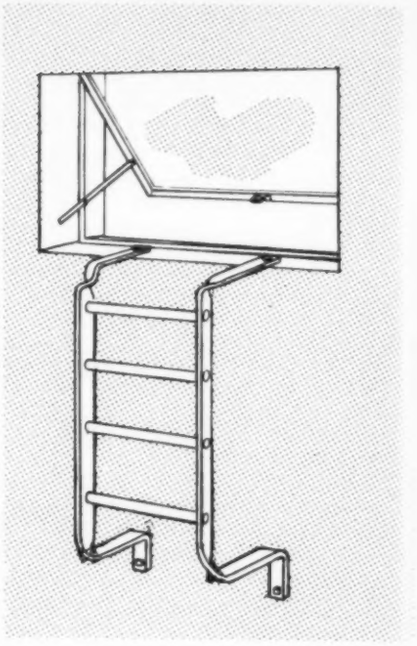
On the other end, an eye-bolt is attached to the chain and inserted through the open pipe fitting and through a hole drilled to fit the bolt. A nut is placed on the threaded end of the bolt and tightened to give the removable chain rail the proper tension.

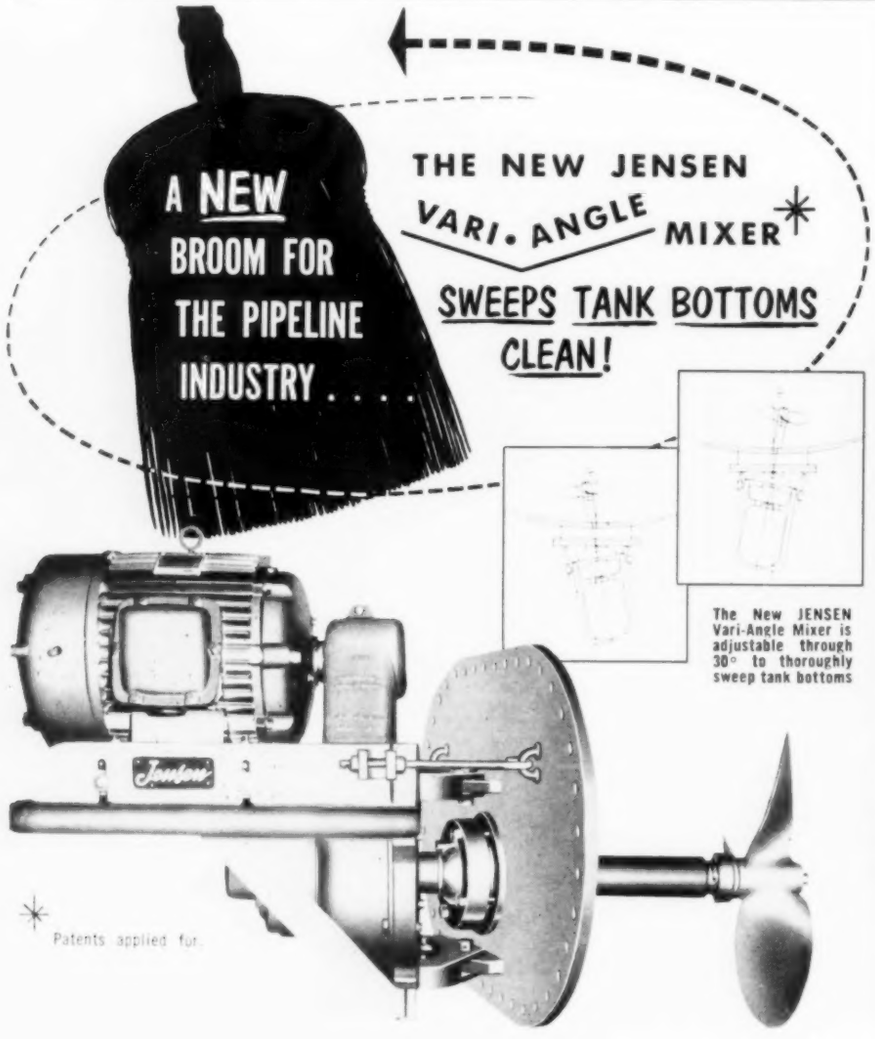
With this arrangement, the chain can be unfastened to permit passage of tools and cylinders, and the rest of the hand rail kept in place during overhaul.

Ladder Aids Quick Escape From Station Basement

As a safety measure, one operator at a Southwest compressor station made up and installed short ladders in the basement of the compressor building as shown. This ladder would speed escape from the basement in emergencies.

The ladder is made of ¼ by 1-inch steel plate twisted to the configuration shown. Four ¾-inch steel rods are welded in place for ladder rungs. The assembly is bolted to the window sill and wall.




A NEW BROOM FOR THE PIPELINE INDUSTRY . . . .
THE NEW JENSEN VARI-ANGLE MIXER
SWEEPS TANK BOTTOMS CLEAN!
The New JENSEN Vari-Angle Mixer is adjustable through 30° to thoroughly sweep tank bottoms
Jensen
Patents applied for.

The JENSEN Vari-Angle Mixer was designed principally for use on crude tanks to remove and prevent the deposit of B. S. & W. You direct the flow for efficient and economical cleaning when you use the Vari-Angle. JENSEN accomplishes the directed flow stream by varying the angle of the mixer during operation, 15° to either side, or a total sweeping action of 30°.

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Jensen ENGINEERING COMPANY
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Ice Tongs Are Useful In Pulling Oil Filters

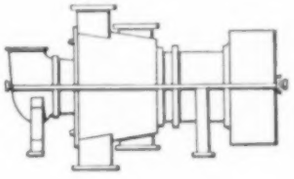
A pair of ordinary ice tongs can do the job of pulling oil filters better than usual methods. The problem in pulling filters is to get the whole filter out without leaving broken off pieces in the lubricating system. This often happens with old, worn-out filters when they swell up and their components are loosened.

Ice tongs will dig into the filter and get a firm grip on the whole unit, permitting a much cleaner and easier removal.

Westinghouse 5000-hp gas turbine

gives you the reliability you want

The mechanical simplicity and conservative design of Westinghouse turbines give you the reliability you expect and want in pipeline service. • The complete absence of sliding motion reduces friction and wear to an absolute minimum. • There is no cooling water system required. • Permanent alignment is assured by turbine's rigid construction — no bedplate is needed. • The highly precise hydraulic governing system has been proved on millions of horsepower of steam turbines.



For more information, see your Westinghouse sales engineer, or write for booklet DB-1515 to Westinghouse Electric Corporation, 3 Gateway Center, Pittsburgh 30, Pa. J-50590

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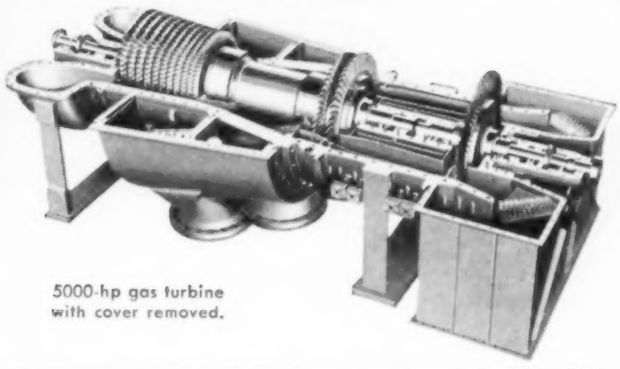


5000-hp gas turbine with cover removed.

Pipe Line Men

IN THE NEWS

George T. Naff

O. S. Carpenter

Texas Eastern Transmission Corporation has announced the appointment of **George T. Naff,** president of the company, as vice chairman of the board and **Orville S. Carpenter** to the post of president and member of the board of directors. Carpenter has been vice president and comptroller.

Naff will have general supervision of the affairs of the company with emphasis on growth and diversification as well as the financing program which Texas Eastern will undertake. Carpenter will exercise executive authority in the operations of the company. As comptroller, Carpenter was the officer who supervised the details of transferring possession of the "Big and Little Inch from the government to Texas Eastern in 1947 and served as chief financial officer of the company during the initial public financing which led to the final purchase of the lines in 1947. Carpenter was elected a vice president in 1950.

•

Southern California Gas Company has announced the reorganization of the top management with **W. R. Davis** becoming executive vice president and **R. R. Blackburn** made senior vice president. **A. W. Strong,** now assistant vice president, has been elected vice president in charge of personnel and **C. A. Renz,** present manager of special services, is elected vice president responsible for special services and customers departments. The changes are as a result of the resignation of **W. M. Jacobs,** who became a vice president of the Pacific Lighting Corporation, San Francisco, October 1. Davis, the newly appointed executive vice president, will participate with **F. M. Banks,** president, in the over-all responsibility for the management of the company. Blackburn is assigned a new position in the gas company organization and will have responsibility for several major operating functions, including gas distribution, customer accounting, customer service, special services, engineering, gas transmission and division coordination.

•

Harold D. Skyrm, vice president of **General American Transportation Corporation,** has been elected to the board of directors. Skyrm has been vice president of the company since 1949. He became associated with a subsidiary of General American in 1922 in the Engineering department in Kansas City, Kansas. Later he was transferred to sales in the Tulsa, Okla., office and became district sales manager of that office in 1935. From 1943 to 1946 Skyrm served as Pacific Coast manager with headquarters in Los Angeles, then came to the Plate and Welding division of the company as sales manager. In 1948 he took over the Process Equipment division.

•

Joseph A. Salerno has been named to the newly-created position of field representative at Wichita, Kansas, for the gas purchase section of **Northern Natural Gas Company.** Salerno will be assigned to gas purchase activities in Kansas, Oklahoma and Colorado. He has been with Northern for eight years, most recently as a field measurement man at Garden City, Kansas.

Joseph A. Salerno

•

El Paso Natural Gas Company has announced several personnel promotions. **Arnold La Force** has been named financial vice president of El Paso Natural with headquarters in New York. Formerly he was vice president of the Metropolitan Life Insurance Company. **Newton C. Davis,** who started with the company in 1948 as a utility man at the Tucson station, has been made chief operator at Gallup compressor station. **Alvin Begley** has been promoted to superintendent of the Tucson district, with headquarters at Tucson City Gate. He replaces **Hayden Pyeatt,** who has taken over as Arizona area superintendent. **Don R. Parker** has been promoted to chief storekeeper at the San Juan division warehouse.

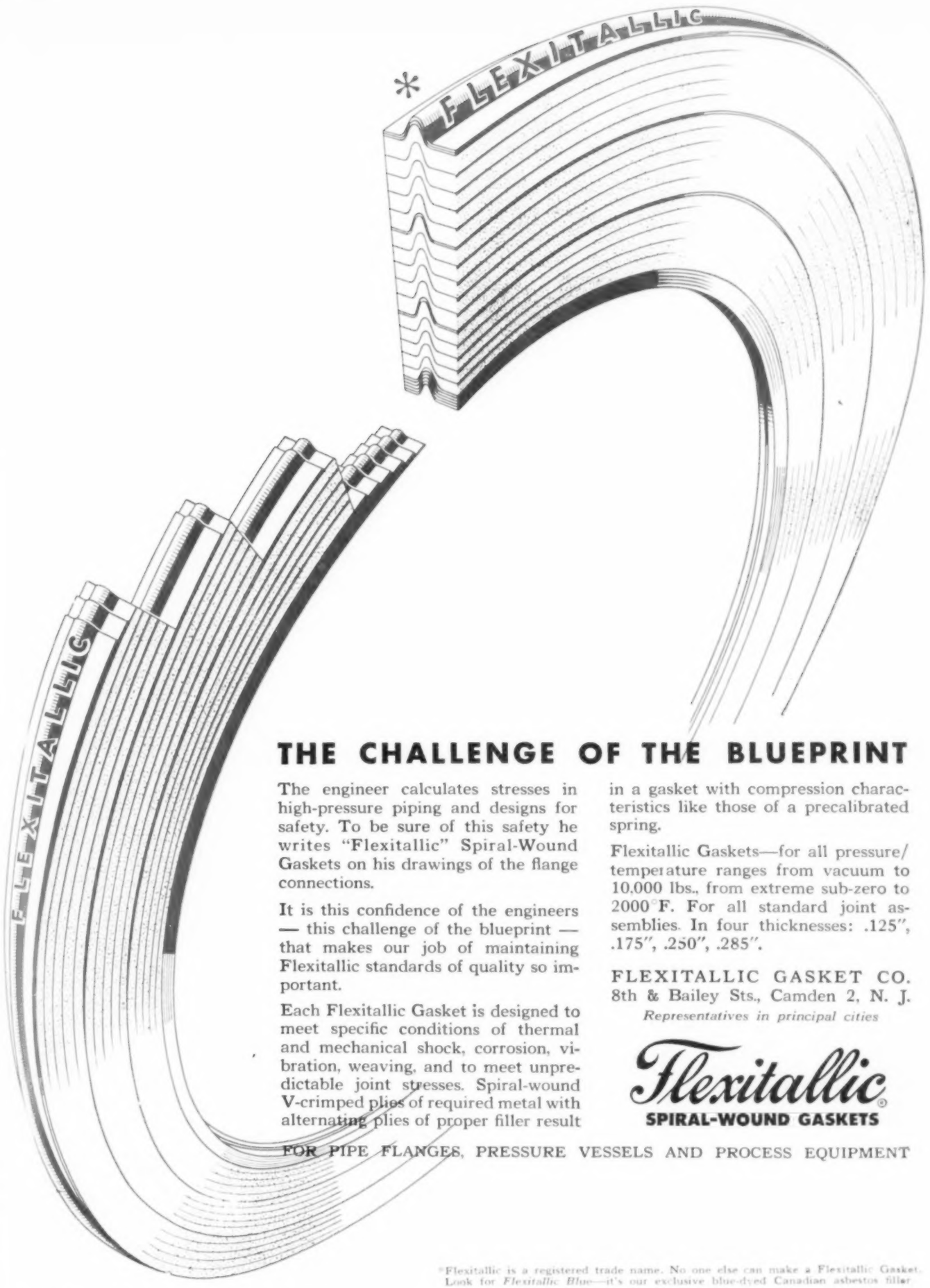
•

Interstate Oil Pipe Line Company has announced the appointment of **E. W. Bergquist** as acting district superintendent of the company's Billings, Mont., district. Bergquist, who has been assistant district superintendent of the Magnolia, Ark., district of Interstate, replaces **Hermon S. Foote,** who is on leave. **K. C. Smith,** district foreman in Interstate's Brookhaven, Miss., district, has been named to succeed Bergquist in Magnolia.

E. W. Bergquist

Beginning his pipe line career in 1938 in the company's Engineering department in Shreveport, Bergquist later served as district engineer in the Raceland, La., and Brookhaven, Miss., districts. In 1947 he was named safety engineer and became training and safety advisor, a position he held until his promotion to assistant district superintendent at Magnolia in 1955.

Smith is a veteran pipe line construction and operation supervisor with about 28 years of service. He started with the company in 1927 and later served with Humble Oil & Refining Company and Humble Pipe Line Company. Smith served six years as construction supervisor with Tropical Oil Company in Colombia, South America. He returned to the U. S. and joined Standard Oil Company of Louisiana Pipe Line department. Since that time he has served in many operating capacities including terminal foreman, connection foreman, district gager, district fore-



THE CHALLENGE OF THE BLUEPRINT

The engineer calculates stresses in high-pressure piping and designs for safety. To be sure of this safety he writes "Flexitallic" Spiral-Wound Gaskets on his drawings of the flange connections.

It is this confidence of the engineers — this challenge of the blueprint — that makes our job of maintaining Flexitallic standards of quality so important.

Each Flexitallic Gasket is designed to meet specific conditions of thermal and mechanical shock, corrosion, vibration, weaving, and to meet unpredictable joint stresses. Spiral-wound V-crimped plies of required metal with alternating plies of proper filler result in a gasket with compression characteristics like those of a precalibrated spring.

Flexitallic Gaskets—for all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses: .125", .175", .250", .285".

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SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

man and assistant district superintendent with most of his service being in Interstate's Ferriday, La., and Brookhaven, Miss., districts.

•

Norman Hardy, vice president of **Arabian American Oil Company,** has been elected executive vice president. He started his oil business career in 1926 as a geologist with Standard Oil Company of California, served in several overseas and domestic posts until he joined Aramco in 1951. Hardy continues his location at Dhahran, Saudi Arabia.

Harry C. Jones, Service Pipe Line Company division manager at Raytown, Mo., retired September 1 after more than 40 years of continuous service. Jones supervised 1200 miles of line, pump stations and 202 employes in the company's Missouri division. Jones started with Service as a timekeeper in 1916 and progressed through every level of field management. He was superintendent of construction on the western segment of the company's recently completed Wyoming-Missouri pipe line. In 1948 Jones was assistant division manager for the company's Oklahoma division. He became division manager of the Nebraska division in 1952 and moved to Raytown, Mo., as division manager in 1955.

Harry C. Jones

•

M. L. Bright has been appointed pipe lines manager of **British American Oil Company Limited.** Bright will be responsible for the company's pipe line operations in western Canada. Before joining British American as pipe lines manager, Bright was staff assistant to the general manager of pipe lines, Gulf Oil Corporation, in Houston. After graduation from Texas A & M College, Bright joined Gulf Refining Company and was associated with all phases of pipe line construction and operation. Bright will be headquartered in Calgary and will replace **J. J. Thorp** who has returned to the U. S.

•

George H. Meason, formerly with the Technical and Research department of Humble Oil & Refining Company, Baytown, Texas, has joined **Tennessee Gas Transmission Company** as chief process engineer. Meason will develop a technical organization within the company's plants and Processing department. He and his staff also will be available in connection with processing and technical problems of the Bay Petroleum Corporation, subsidiary of Tennessee Gas. Meason joined Humble in 1940 and served as chemical engineer at Humble's Ingleside refinery near Corpus Christi, Texas, before moving to Baytown. In 1947 he became senior chemical engineer, was named section head in the technical service division in 1950 and became acting assistant division head in 1953.

George H. Meason

•

Frank M. Ross, lieutenant governor of British Columbia, has become a

5 YEARS

SALT FLAT

THIS PIPELINE IN LOUISIANA is subjected to conditions about as corrosive as you could find. Lying in salty muck, sometimes completely submerged, it is exposed to atmospheric temperatures varying from below freezing to over 100 degrees. When laid five years ago, this line was coated with our LION E-120. A recent inspection, made at the time this photograph was taken, showed the coating to be intact. No sign of disbonding could be found and there was no checking or cracking.

ABOVE GROUND OR UNDERGROUND *protect your pipelines with Lion E-120—one coating for year-round application. Write today for specifications and quotations.*

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FIRST NATIONAL BANK BUILDING TELEPHONE 5-3468
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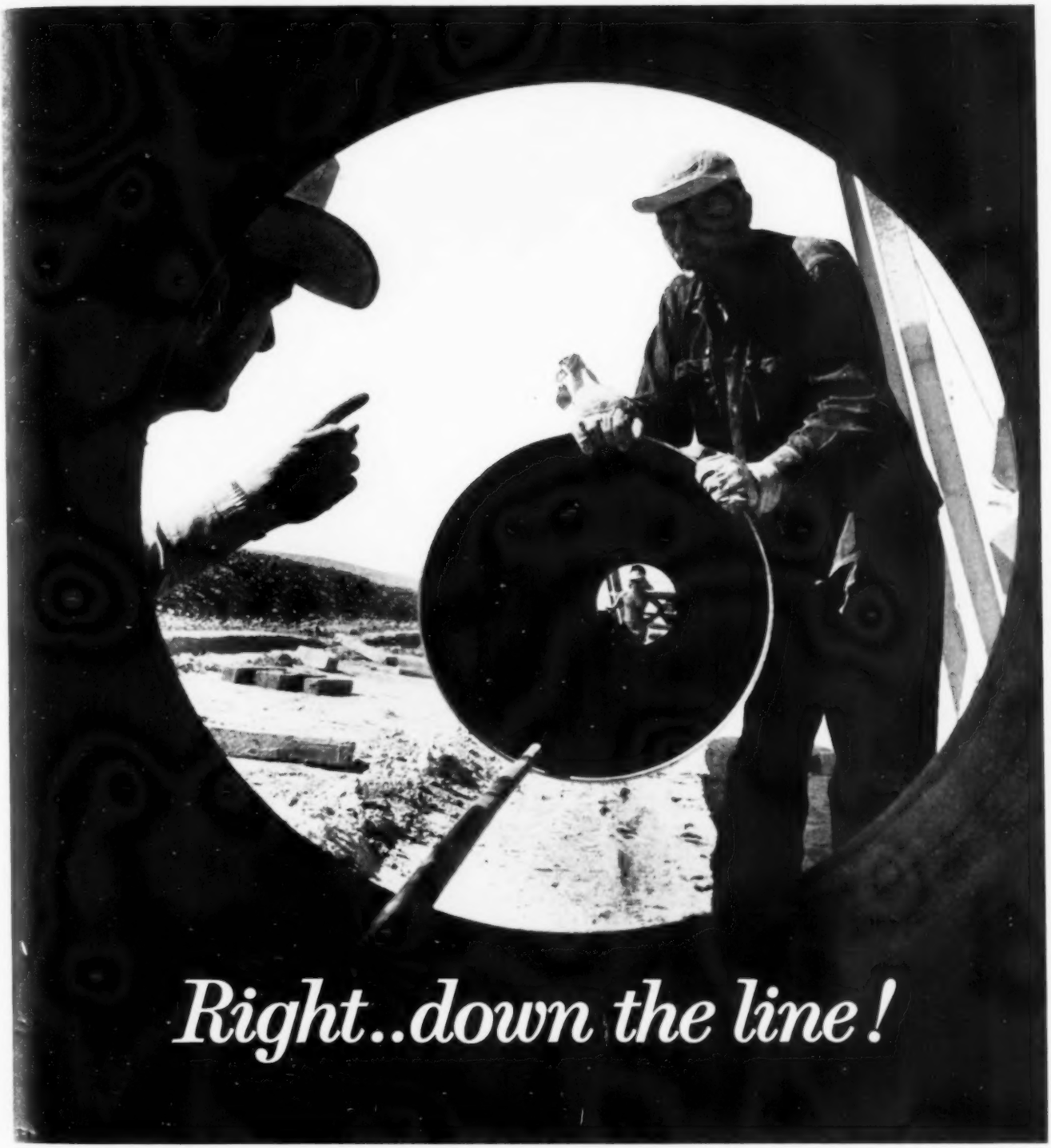
HOLCOMBE COMPANY OF CANADA, INC.
323 BARKER BUILDING TELEPHONE 6-7291
CALGARY, ALBERTA, CANADA

Lion Coatings • Holcombe Selenium Rectifiers
Pipe Wrappings • Graphite Anodes • Coke Breeze



PACIFIC NORTHWEST PIPELINE CORPORATION PHOTOGRAPH.

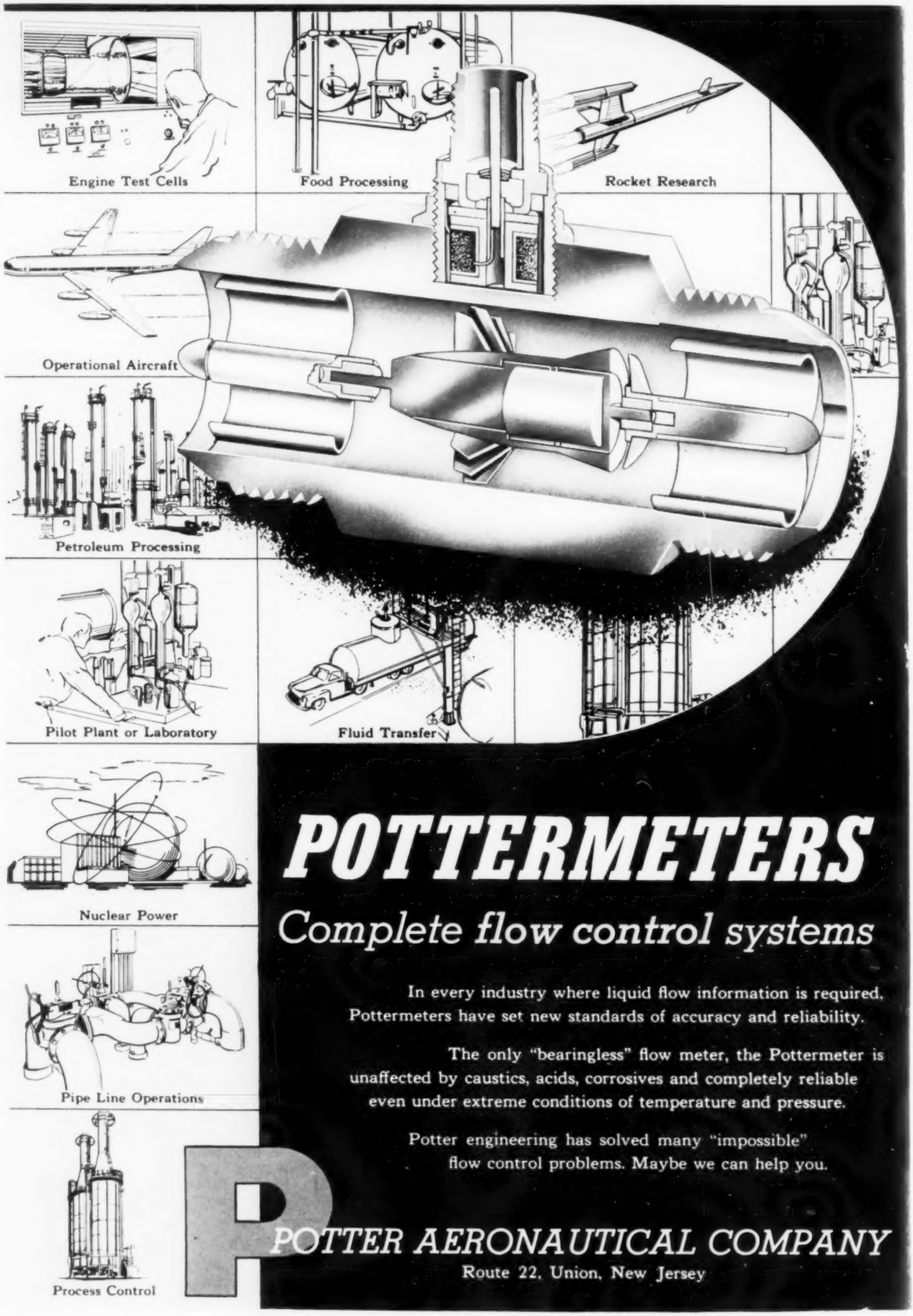
Quality, uniformity, precision—these are watchwords that you can always depend on when you use Kaiser Steel Line Pipe.

For example, Kaiser Steel Line Pipe—20 inch OD and larger—is placed in restraining dies and expanded by water under great pressure. This hydraulic expansion assures accurate diameter, concentricity and straightness—and also strengthens the pipe through additional cold working. Another example of the painstaking care that goes into the manufacture of pipe from Kaiser Steel.

Next time you are ordering line pipe, specify Kaiser Steel Line Pipe. Rely on Kaiser Steel quality and service to add dollars to your operating profits.

Kaiser Steel

Steel Mill Products: plates • hot rolled strip and sheet • cold rolled strip and sheet • tin plate • continuous weld pipe • electric weld pipe • alloy and carbon bars • bar shapes • structural shapes • semi-finished steels • pig iron • ingot molds • coke by-products • **Fabricating Division:** steel fabrication for construction, aircraft, missile and other industries • expanded fusion weld pipe • reinforced concrete pipe • tanks • For specifications, write: **KAISER STEEL CORPORATION** • **Los Angeles** • **Oakland** • **Seattle** • **Portland** • **Phoenix** • **Denver** • **Tulsa** • **New York**



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Complete flow control systems

In every industry where liquid flow information is required, Pottermeters have set new standards of accuracy and reliability.

The only "bearingless" flow meter, the Pottermeter is unaffected by caustics, acids, corrosives and completely reliable even under extreme conditions of temperature and pressure.

Potter engineering has solved many "impossible" flow control problems. Maybe we can help you.

POTTER AERONAUTICAL COMPANY

Route 22, Union, New Jersey

ember of the board of directors of **Westcoast Transmission Company Limited.** •

R. K. Kelly will head **Tidewater Oil Company's** newly organized transportation department and will coordinate the Marine, Pipe Line and Traffic departments, as well as the trucking, bulk terminal planning and inventory control units. Kelly, who has been manager of the Eastern divisison Marine department, will remain in New York. He has been with Tidewater continuously since 1929, except while on leave from the company during World War II, when he served the Petroleum Administration for War as assistant director of supply and transportation scheduling the operation of privately owned tankers. •

R. K. Kelly

Ralph L. Andreas, who has been associated with the railroad business for more than 25 years, has been appointed traffic manager of **Standard Oil Company (Indiana).** Andreas, vice president of sales and services for Rutland Railway Corporation, Rutland, Vt., will succeed **Lee R. Cowles,** who is retiring after 19 years with Standard to become transportation commissioner for the Kansas City, Mo., Chamber of Commerce. **Elmer C. Pritz,** assistant to the traffic manager and with more than 40 years' company service, will be promoted to assistant traffic manager to succeed **Robert W. Fyfe,** who retires in November after more than 38 years as assistant traffic manager of Standard. •

Ralph L. Andreas

Foster Associates, a new firm providing economic and engineering services for natural gas producers dealing with the Federal Power Commission, has been formed in Washington, D. C. **J. Rhoads Foster,** gas economics authority, heads the firm and **Radford L. Schantz** is an associate.

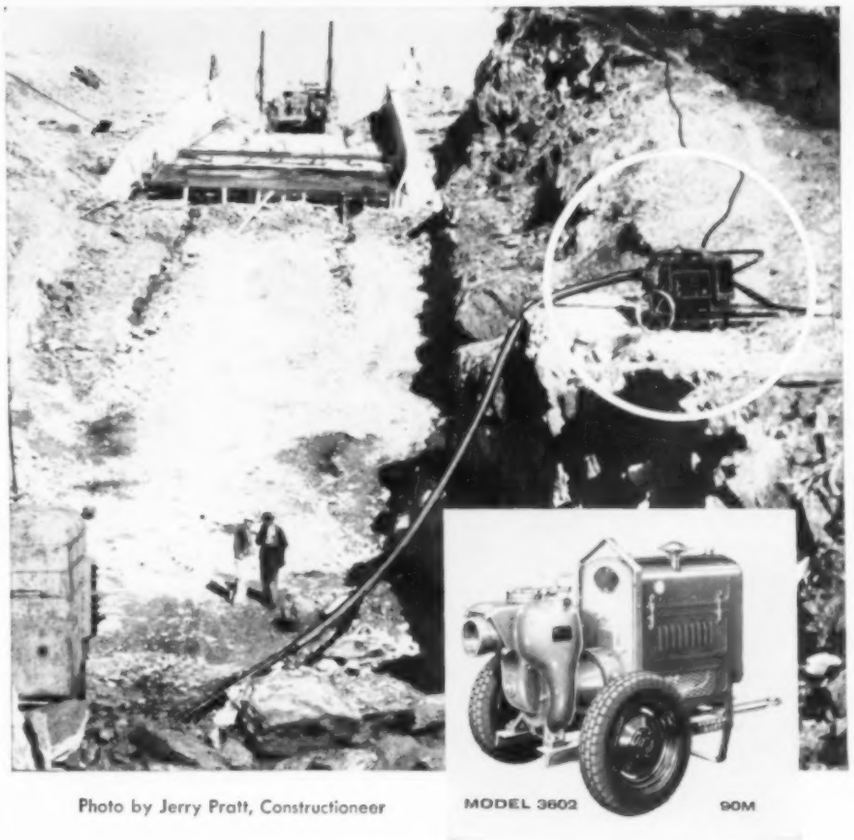

Photo by Jerry Pratt, Constructioneer

MODEL 3602 90M

Gorman-Rupp Drainage Pump KEEPS PENNA. DAM JOB MOVING

Seepage on construction near Spring Grove, Penna., is quickly removed by a Gorman-Rupp 90M Pump, Model 3602, letting work proceed on the removal of solid rock. The pump stands about 20 feet above water level and is discharging over the rise as shown in the upper right of the picture. The 500-ft. spillway chute handles overflow from the 2½-sq.-mi. dam.

Dewatering problems encountered on this job are identical to those in pipeline construction. Put Gorman-Rupp on the job before you have trouble. Our plain-language guarantee is backed by a long record of proved performance on the job.

Send coupon below to our Mid-Continent & Gulf Coast Oilfield Representative for the 24-page Gorman-Rupp Oilfield Catalog. It describes the many models of Gorman-Rupp Pumps useful in your business. The Gorman-Rupp Company, 305 Bowman Street, Mansfield, Ohio.

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Transcontinental pipelines are among the many places where Cathodic Protection and Anaconda Type CP Cable are used to check corrosion.

Cable that helps make the pipeline a good neighbor

To make cathodic protection systems more economical and effective – to help pipeline and oil companies check costly corrosion, stop leaks, make pipelines good neighbors – Anaconda offers a special Type CP Cable that *lasts far longer* on the job than ordinary cable.

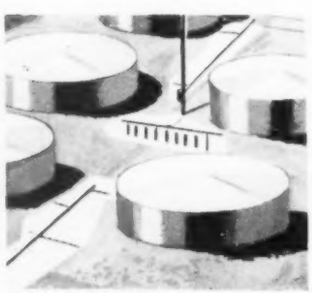
High-grade polyethylene insulation and tough Densheath* (PVC) jacket offer high resistance to electroendosmosis†, as well as high resistance to oil, moisture, and most acids, alkalies and chemicals found in corrosive areas. And rugged Densheath withstands toughest abrasion, moisture, sunlight and weathering.

For special applications, a one-layer insulation and jacket construction of polyethylene is available.

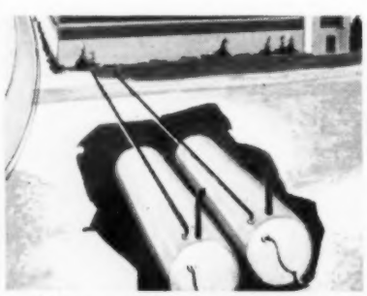
To order, or for more information – call the Man from Anaconda. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

*Reg. U.S. Pat. Office †Cable failure on direct current in wet locations. 56357 Rev.

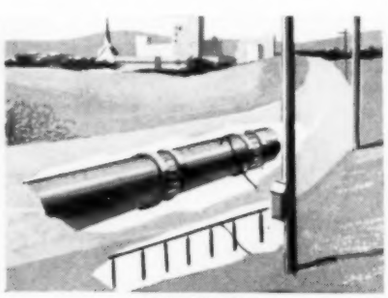
WHERE ANACONDA TYPE CP CABLE AND CATHODIC PROTECTION CUT CORROSION COSTS



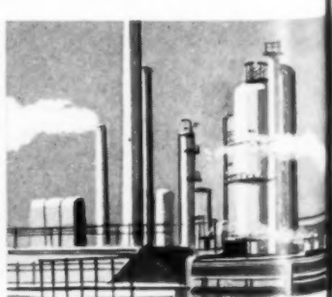
Tank farms



Underground storage tanks



Pipelines



Oil refineries

ASK THE MAN FROM **ANACONDA**

FOR **CATHODIC PROTECTION CABLE**

W. T. Askew

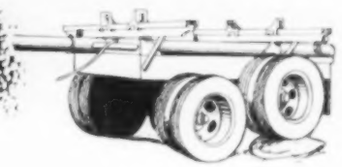
John C. Agnew

W. T. Askew, president of Sun Oil Company, Ltd., has been elected a member of the board of directors of **Sun-Canadian Pipe Line Company, Ltd. John C. Agnew,** director and treasurer, has been elected secretary and **John Blair Moffett** has resigned as secretary and a director. Askew has been associated with Sun Oil Company for 25 years. This year he became the first resident president of Sun Oil Company, Ltd. Agnew joined Sun Oil as auditor in 1920, becoming assistant secretary and assistant treasurer in 1947. In 1949 he was elected secretary and treasurer and a member of the board of directors with offices in Philadelphia.

•

Shell Oil Company has announced three staff changes in its Pipe Line department. **R. A. Harvey,** superintendent of the Central division, products pipe lines, will be on special assignment for the department during the next year. His office will be in Indianapolis. **R. K. Schultze,** technical assistant to the manager of the Pipe Line department, will become acting superintendent of the Central division and **R. R. Marichal,** recently transferred from the Pacific Coast, will act as technical assistant to the manager in Schultze's absence. Harvey joined Shell in 1940 as a chemical engineer in the Transportation and Supply section of products pipe lines, Zionsville, Ind. Since then he has served in various technical and supervisory capacities in East Chicago, Ind., Wood River, Ill., Toledo, Ohio, and Indianapolis. Schultze has been with Shell since 1937. He began with the company as a junior safety engineer in St. Louis and moved to New York in 1941. He joined the Transportation and Supply section of products pipe lines in 1952. Marichal joined Shell as an engineer-trainee in 1948 in Los Angeles. He served in various technical positions on the Pacific Coast until his transfer to the head office, New York, this year.

CROSS COUNTRY



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Here is your top-quality pipeline trailer that's really built for cross-country... on or off the highway. Double-pivot tandem for axle equalization and longer tire life. Exclusive hi-tensile, pressed-steel frame permits greater payload. Carrying on the Spencer tradition of quality, the Pipeliner combines lightweight with extreme ruggedness at a moderate price.

Choose among Spencer Oil Field Floats, Pole trailers, low beds. Available in tandem or single axle

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"... a most practical on-the-job manual for men concerned with pipe line corrosion. We are ordering copies for each of our district engineers."

Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This Handbook, written by Marshall E. Parker, consultant, is designed as a practical field manual. It is a 108-page pocket-size volume printed first as a popular series in WORLD OIL. The Handbook is illustrated with many charts and drawings and is completely indexed by subjects.

It presents comprehensive data on Soil Resistivity Surveys, Potential Surveys, Line Currents, Current Requirements, Rectifier Systems, Ground Bed Design, Magnesium Anodes, Stray Current Electrolysis, Interference in Protective Systems, Operations and Maintenance, and Coating Protection and Testing.

An appendix has been added of technical data on Underground Corrosion, Basic Principles of Cathodic Protection, Properties of Metals and Attenuation Equations. Order copies of this practical Field Manual now for each of your field men. Price $3.

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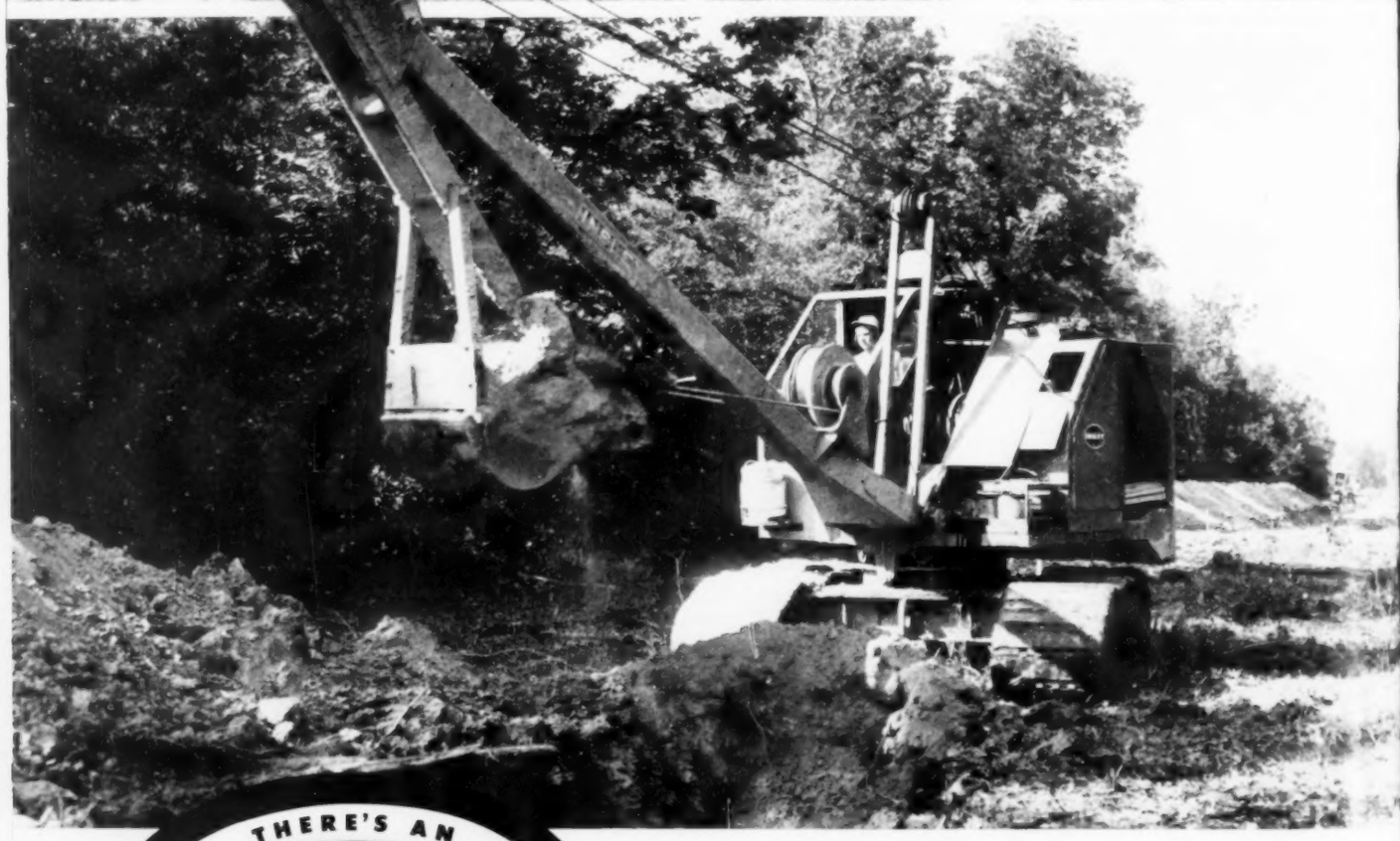

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The Insley "Pipeliner" is fully convertible for hoe, shovel, dr gline clamshell and crane work, and is available with gasoline or diesel ower

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WHO'S MEETING WHERE

November

American Petroleum Institute, Annual Convention, Conrad Hilton Hotel, Chicago, Nov. 12-15.

NACE, Western Regional Division Conference, Lafayette Hotel, Long Beach, Calif., Nov. 15-16.

American Society of Mechanical Engineers, Statler Hotel, New York, Nov. 25-30.

January

Pipe Line Contractors Association, Ninth Annual Convention, Boca Raton Hotel and Club, Boca Raton, Fla., Jan. 14-16, 1957.

American Institute of Electrical Engineers, 1957 Winter General Meeting, Hotel Statler, New York, Jan. 21-25.

February

NACE, Tulsa Section, Corrosion Short Course, Mayo Hotel, Tulsa, Okla., Feb. 13-15.

March

NACE, 13th Annual Conference and Exhibition, St. Louis, Mo., March 11-15, 1957.

New England Gas Association, Annual Meeting, Hotel Statler, Boston, Mass., March 21-22, 1957.

Mid West Gas Association, Hotel Nicollet, Minneapolis, March 25-27.

April

Petroleum Equipment Suppliers Association, Palm Springs, Calif., April 6-11, 1957.

AGA Distribution, Motor Vehicles and Corrosion Conference, Rice Hotel, Houston, April 8-11.

American Welding Society, Sheraton & Bellevue Stratford Hotels, Philadelphia, April 8-12.

Southwestern Gas Measurement Short Course, College of Engineering, University of Oklahoma, Norman, April 16-18.

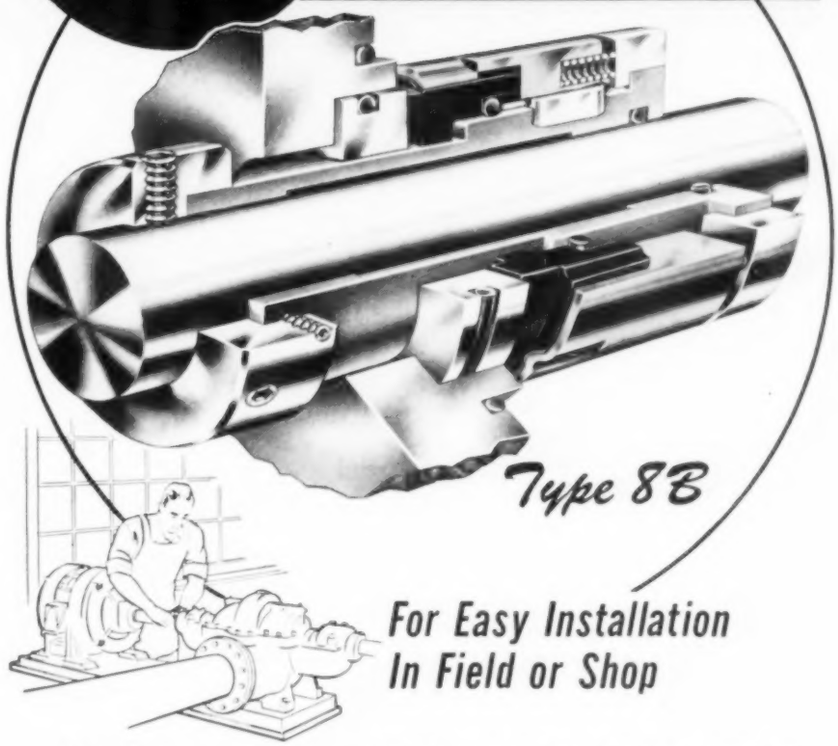
Southern Gas Association, Annual Convention, New Orleans, April 29-May 1.

May

AGA Gas Supply, Transmission and Storage Conference, Mark Hopkins Hotel, San Francisco, May 9-10.

JOHN CRANE

PACKAGED TYPE MECHANICAL SEALS FOR High Pressure Pipe Line Pumps



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Manufacturers of large centrifugal pumps and pipe line operating engineers have long been asking for an end face mechanical seal meeting these requirements: 1) heavy-duty design to handle high pressure applications; 2) single-unit packaged construction for easy installation; 3) a full range of sizes to meet individual specifications.

"John Crane" has met this need with the Type 8B hydraulically balanced seals for pressures to 1200 psi.

These seals can be quickly installed and adjusted simply by sliding the entire unit along the shaft into final position. Removal of the top casing is not necessary. This feature alone results in the saving of many man-hours of maintenance work.

Field reports and performance records point to the steadily increasing use of "John Crane" high pressure seals to eliminate problems connected with the handling of hydrocarbons, crudes, gasoline and other petroleum products.

To help you in your individual requirements, "John Crane" offers nationwide service—available without obligation from strategically located factory owned branch offices.

Write for illustrated high pressure seal bulletin.

Crane Packing Co., 6434 Oakton St., Morton Grove, Ill., (Chicago Suburb).

In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.

JOHN CRANE CRANE PACKING COMPANY

For more data on advertised products, use Readers' Service Cards, last page.

What's Happening

AMONG SERVICE AND SUPPLY MEN

McLaughlin Heads Schramm's New Petroleum Division

Schramm, Inc. has announced the formation of a Petroleum division to be headed by Philip L. McLaughlin, former drilling editor of WORLD OIL, and more recently director of drilling research for Cardwell Manufacturing Company, Wichita, Kansas.

Philip L. McLaughlin

Schramm's new Petroleum division will function as a separate sales dealer and research branch of the parent company but will use some of the existing dealer and sales organization to promote newly-designed equipment for air drilling and other petroleum industry applications.

McLaughlin formerly served as an executive assistant to H. W. Cardwell, Sr., president of Cardwell Manufacturing Company, until its acquisition by John W. Mecom, Houston oil man, in January, 1956. McLaughlin was in charge of drilling research, advertising and sales promotion. Under Mecom his duties were expanded to include market research director.

McLaughlin has been with Continental Oil Company and The Ohio Oil Company.

J. I. Case Approves Merger With American Tractor

The boards of directors of the J. I. Case Company of Racine, Wis., and the American Tractor Corporation of Churubusco (Fort Wayne), Ind., have approved plans for a merger that would give Case entry into the construction and roadbuilding fields with a line of crawler tractors and earthmoving equipment.

The proposed merger will be submitted to stockholders of both companies as soon as the legal requirements have been met and the detailed merger agreement completed.

American Tractor has grown in the construction equipment industry and is one of the six full-line producers of crawler tractors and equipment in this country. It started manufacturing in 1950, and in the past two years has increased its volume more than 400 percent.

The 114-year old J. I. Case Company, manufacturers of rubber-tired tractors and farm machinery, plans to devote a substantial portion of its seven million square feet of plant facilities to the roadbuilding and construction field. The proposed merger would give Case a diversified line of rubber-tired and crawler tractors and equipment extending from the agricultural field to construction, materials handling and roadbuilding.

The merged companies will operate as the J. I. Case Company.

Westinghouse Announces Gas Turbine Appointments

Appointments to fill top positions in Westinghouse Electric Corporation's newly-created Industrial Gas Turbine department at the Lester, Penn. plant have been announced.

C. J. Burke was promoted to sales manager and E. J. Fogel was promoted to manufacturing manager. T. J. Putz will continue in his capacity of engineering manager for industrial gas turbines.

Burke joined Westinghouse in 1948 on the graduate student course. Prior to his new appointment he served in various capacities with the gas turbine sales section. Fogel started his career with Westinghouse in 1931. He became a foreman in 1941, and a year later he was appointed a manufacturing engineer and assigned responsibilities on U. S. Navy programs. In 1953 he was appointed assistant superintendent of the industrial gas turbine section, and in 1955 he became superintendent.

Royston Laboratories Appoints L. P. Brown, Jr. Regional Manager

Royston Laboratories, Inc., manufacturers of Roskote cold applied pipe mastics, anti-corrosion products and industrial coatings, has appointed Linn P. Brown, Jr., as regional manager covering the New England and Middle Atlantic area.

Jones & Laughlin Supply Names Bouldin District Sales Manager

Robert T. Bouldin, formerly assistant district sales manager for Jones & Laughlin Supply division in the Northern Oklahoma district since August, 1953, has been appointed district sales manager of the North Texas district with headquarters at Wichita Falls, Texas. Bouldin succeeds W. R. Layne, who has been assigned to the southern Oklahoma district as general salesman with headquarters at Ardmore, Okla.

Robert T. Bouldin

Bouldin joined J & L Supply in 1935 as a storeman at Kilgore, Texas, later serving as store manager and field salesman. Later he served as store manager in Longview, Texas, and as assistant district sales manager in the West Texas district based in Odessa, Texas. Layne has been with the firm since 1934 when he started as a storeman at Healdton, Okla. Prior to his appointment as district sales manager of the North Texas district in June, 1952, he had served as local store manager and sales representative at various store points in Oklahoma and Texas.

Two Sales Representatives Named by J & L Supply Division

T. G. Row and P. J. Fischer, Jr., have been appointed sales representatives at Rangely, Colo., and St. Elmo, Ill., for Jones & Laughlin Supply division.

Row, formerly manager of the J&L Supply store at Rangely since April, 1953, has been with the firm since 1949, when he started as a storeman at Powell, Wyo. Later, he served in the capacities of field salesman and local store manager at various points in South and North Rocky Mountain districts.

Fischer joined J&L's Wichita Falls, Texas, store force as a storeman in 1951, and remained there until his transfer to the Sherman, Texas, store in 1955. Prior to his recent assignment, he had served as a sales representative in the Sherman area since 1955.

Thomas E. Dawson to Represent Oilwell at Wichita, Kansas

Thomas E. Dawson, 37-year veteran with the Oil Well Supply Division of U. S. Steel Corporation, has been named city representative at Wichita, Kansas.

T. E. Dawson

Dawson, who joined Oilwell in 1919 at Ponca City, Okla., has had more than 20 years of service in Kansas, where he has held various sales posts in most of the state's major oil field areas. His locations include El Dorado, Russell, Ellinwood and Great Bend. He transferred from Great Bend in 1949 to Wichita where he has been located since.

Smith Named Traffic Manager At Colorado Fuel & Iron Division

Gordon P. Smith has been appointed general traffic manager of the Eastern division of The Colorado Fuel and Iron Corporation. Smith succeeds Harry H. Marsales, who retired as traffic manager after 41 years with CF&I.

Smith will be in charge of the Traffic departments of all plants of the company's Wickwire Spencer Steel Division, and of the American Wire Fabrics Corporation and John A. Roebling's Sons Corporation, both wholly-owned subsidiaries of CF&I. He will continue to be located at the corporation's offices in Claymont, Del.

Smith has been associated with the Claymont plant since 1947. He has been division traffic manager at Claymont, which is a part of the Wickwire Spencer Steel division, and also supervisor of transportation at Claymont plant. Prior to CF&I's acquisition of the plant in 1951, he had held the position of general traffic manager.

Prior to his association with Claymont and CF&I, Smith served as traffic supervisor for the General Chemical division of the Allied Chemical & Dye Corporation.

Previously, Smith was associated for nearly ten years with E. I. du Pont de Nemours & Co.

Westinghouse Electric Names Reese H. Taylor Director

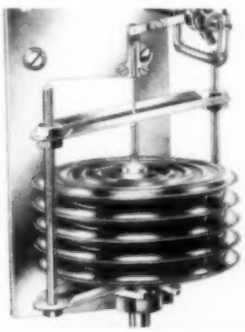
Election of Reese H. Taylor, board chairman of Union Oil Company of California

How much do you know about Recording Pressure Gauges?

1 **Q.** Why are more Bristol Recording Gauges used than all others combined?

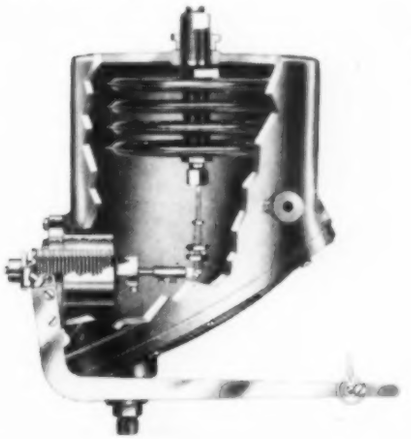
A. BRISTOL'S PRESSURE MEASURING ELEMENT, heart of the pressure gauge, is the big reason. Bristol Pressure Gauges, operating all over the world under all conditions – some in constant service for 20, 30, even 40 years – prove its accuracy, long life, and stability.

2 **Q.** What's the *right* measuring element for low pressure ranges?



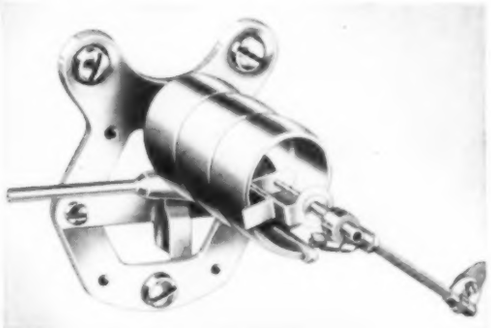
A. BRISTOL'S DIAPHRAGM MEASURING ELEMENT, for ranges from 0–2 in. water to 0–29.9 psi. Extremely high torque gives positive pen positioning across entire range. It's highly accurate, extremely stable. 250% inherent over-range protection.

3 **Q.** What's the *right* measuring element for absolute pressures?



A. BRISTOL'S SINGLE-BELLOWS TYPE ELEMENT. It measures ranges as low as 0–6mm mercury absolute and gives direct reading of pressure above absolute zero corrected for barometric variations – with far greater accuracy than ever before.

4 **Q.** For intermediate and high pressures?



A. CORRECT ANSWER here is either Bristol's *Type 316 stainless steel* or *non-ferrous alloy* helical measuring elements. They're designed for ranges from 0–30 psi all the way up to 0–10,000 psi. Withstand impact of rapid fluctuations, give *permanent* accuracy over a long period of service life.

What do you get for the right answers? A free copy of our 32-page catalog G621. It tells all about Bristol Recording Gauges for recording, automatic controlling, pneumatic transmission and telemetering. Write for it today. The Bristol Company, 114 Bristol Road, Waterbury 20, Conn. 5.21

TRADE MARK BRISTOL'S REG. U.S. PAT. OFFICE

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

as a director of the Westinghouse Electric Corporation has been announced.

Taylor succeeds Marvin W. Smith, resigned, on the Westinghouse board of directors. A native of Los Angeles, Taylor spent his entire business career there except for a time during World War II when he served as chief of the War Production Board's iron and steel branch.

In 1938 Taylor left the presidency of the Consolidated Steel Corporation, which later merged into the United States Steel Corporation, to become president and a director of Union Oil and its subsidiaries.

Ternes and Hance to Assist In Kaiser Steel's Public Relations

Joseph J. Ternes, formerly in charge of the Los Angeles public relations office of Kaiser Steel Corporation, has been appointed assistant to A. P. Heiner, vice president of public relations and traffic. Ternes will render administrative and executive assistance to Heiner, and will take up office in Oakland.

Harrison H. Hance has been named advertising manager. He will also be in charge of publications issued from the Company's home offices in Oakland, including Kaiser Steel's *Westward Magazine*.

Ternes joined Kaiser Steel in 1953 as administrative assistant, public relations and advertising. Before that he was with the Oakland Tribune for 12 years, last serving as circulation promotion manager.

Hance joined Kaiser Steel in 1954 as administrative assistant to the vice president, in charge of advertising and publications. Before that, he was with Kaiser Services for six years, last serving as assistant to the manager, public relations and advertising.

Other duties with Kaiser Services included that of publications manager, and managing editor, Kaiser Publications.

Griffin Elected President Of Daniel Orifice Fitting

Daniel Orifice Fitting Company has announced the election of W. A. Griffin to the office of president.

W. A. Griffin

Griffin joined Daniel in Los Angeles in 1940 and has been vice president and general sales manager since 1950. In his new post he succeeds J. G. Holdenried, who becomes executive consultant.

With Griffin's appointment, Daniel Orifice begins an expansion and development program to include expansion of the Houston plant facilities and a transfer of executive offices from Los Angeles to Houston.

Contracts Let for Addition To Lincoln Electric Plant

Contracts for the $5.5 million building addition to The Lincoln Electric Company's 20-acre plant have been awarded to The Austin Company. The decision to proceed with expansion of the plant was reached in view of increased demand for welding equipment.

The 456,000 square foot building addition is expected to be ready for occupancy in the fall of 1957. William Irrgang, president of Lincoln, reported the Austin Company contract represents the largest single commitment in the $8 million expansion program announced by the company earlier this year.

Sales Executive Changes Made At Taylor Instrument Companies

Frank S. Ward, general sales manager for Taylor Instrument Companies, has been named administrative assistant to the president. Succeeding him will be L. Lawrence Forward, manager of Taylor's Chicago operation.

L. L. Forward

Albert J. Fleig, industrial sales manager, is appointed assistant to Forward, and George Heller, formerly assistant industrial sales manager, will succeed Fleig.

Ward, who joined the company in 1917, has held many responsible positions. Forward, a 25-year man, became manager in Chicago in 1947.

Walworth Company Acquires Grove Valve and Regulator

Walworth Company has contracted to acquire the outstanding capital stock of the Grove Valve and Regulator Company and Grove Controls, Inc., both of Oakland, Calif.

The Grove companies are engaged in

ARCCO
NOW SPECIFIC GRAVITY RECORDING OF LIQUIDS AT ANY DISTANCE
RECORDING TRANSMITTER
Accurate long-distance transmission of specific gravity recordings is no longer a problem with any of the new RMT Models of Arco-Anubis Recording Gravitometers for recording and transmitting liquid gravity records. These instruments combine the mechanism of the standard Arco Liquid Gravitometer with a metameter telemeter transmission system which records and transmits the specific gravity record to control room or other remote location. The interconnecting line may be any two-wire electrical circuit or its equivalent: private wires, telephone circuits, carrier current channels, or radio (VHF or UHF).
The range of the standard instrument is .15 or larger, but instruments with ranges of .10 or .05 can be supplied. Charts are available for more than 75 different ranges of Specific Gravity or Degree A.P.I. Special ranges can be furnished at slight additional cost. Request Bulletin No. 111-R3 for complete details.
RECORDING RECEIVER
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SEND FOR BULLETIN No. 111R3

The real bargain in fittings is based on

KNOWN SAFETY AND QUALITY

Your Nearby Tube Turns' Distributor *gives you complete line service . . . saves you purchasing time . . . gives you the exact fittings for your job.*

SPECIFY "TUBE-TURN* products" and you know you will get top quality and safe, trouble-free service. These fittings meet *all* American Standard and Safety Code requirements. Each is permanently identified by the "TUBE-TURN" trademark with complete size and material designations. Your nearby Tube Turns' Distributor gives you prompt delivery from a complete line stock, and backs the product with the service of Tube Turns' engineering staff. Here is the *real* bargain in welding fittings and flanges.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS

LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

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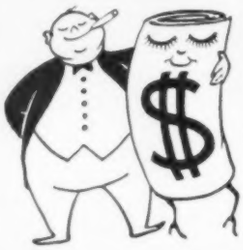

SAVE
On Boiler Maintenance and Shut-downs with

SAND-BANUM

Pure Colloidal Concentrate
Ounces Only Once a Week
REMOVE and PREVENT
Boiler Scale and Corrosion
More Power Less Fuel
Fewer Shut-downs

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For ALL Radiator Cooling Systems Use

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in the Handy Tablets

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AMERICAN SAND-BANUM CO.
ESTABLISHED 1926
MEADOW BROOK NATIONAL BANK BUILDING
FREEPORT, NEW YORK

design and development in controls and ultra high pressure regulators for the gas and oil producing business, and the chemical and petrochemical industries. Government agencies and their prime contractors also are among the principal markets for Grove control devices.

Grove recently constructed a new plant in Longview, Texas. This plant will be made available for Walworth and its subsidiaries to manufacture products for the petrochemical, oil and natural gas markets in the Southwest.

Neale Joins Sales Department Of Peerless Manufacturing

William M. Neale has joined the Sales department of Peerless Manufacturing Company of Dallas. He will serve out of the company's headquarters in Dallas handling sales on all Peerless products, including Peerless line separators, oil and gas separators, dust scrubbers, gas scrubbers, engine timers, gas odorizers, plus Sillers Engineering Company flex ring closures.

William M. Neale

Neale formerly was associated with Phillips Petroleum Company, serving in a variety of assignments in engineering and refinery operations.

GUNITE COATINGS for PIPE LINES

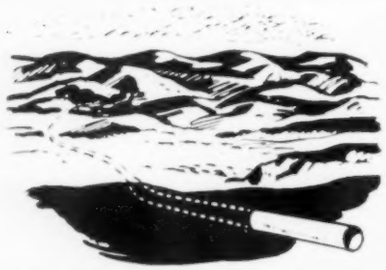
Reinforced GUNITE COATING being applied to pipe.

Your inquiry solicited.

GUNITE CONCRETE & CONST. CO.
1301 WOODSWETHER RD., KANSAS CITY 5, MO.
3206 HOUSTON, HOUSTON 9, TEX.
CHICAGO – ST. LOUIS – DENVER
MILWAUKEE & TWIN CITIES – NEW ORLEANS

DITCHER SALES PROMOTION MANAGER

Wanted: Experienced man to head sales promotional activity of leading manufacturer of expanding ditcher line. Must have sales experience and be familiar with design and application of both wheel and boom type machines. Position involves overall sales management responsibilities with distributors and key customer contacts. Age preferably under 45. Management level compensation. Provide complete experience resume with application. Reply to: Personnel Director, Barber-Greene Company, Aurora, Illinois.



STOP THOSE CORROSION LEAKS ON BURIED OIL, GAS AND WATER LINES WITH "CORECO" RECTIFYING SYSTEMS

Experienced "CORECO" engineers, specialists in design and installation of rectifier and galvanic anode cathodic protection systems, are ready to analyze and solve your corrosion problems.

WHEN YOU THINK OF CORROSION, CALL

"Coreco"

FOR COMPLETE CATHODIC PROTECTION

A Complete Design and Installation Service. Call, wire or write today to

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1506 Zora Street • Houston, Texas
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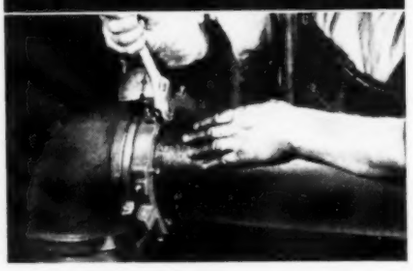
REPAIR LEAKS
QUICKLY—PERMANENTLY



SKINNER-SEAL PIPE JOINT CLAMPS stop leaks at joints. Put on under pressure—without interruption of service. Quick, simple, lasting repair. Sizes 1/2" to 24" incl. in stock.

SKINNER-SEAL COLLAR LEAK CLAMP—designed to stop every type of collar leak in oil and gas lines. Sizes: 2" to 13" inclusive.

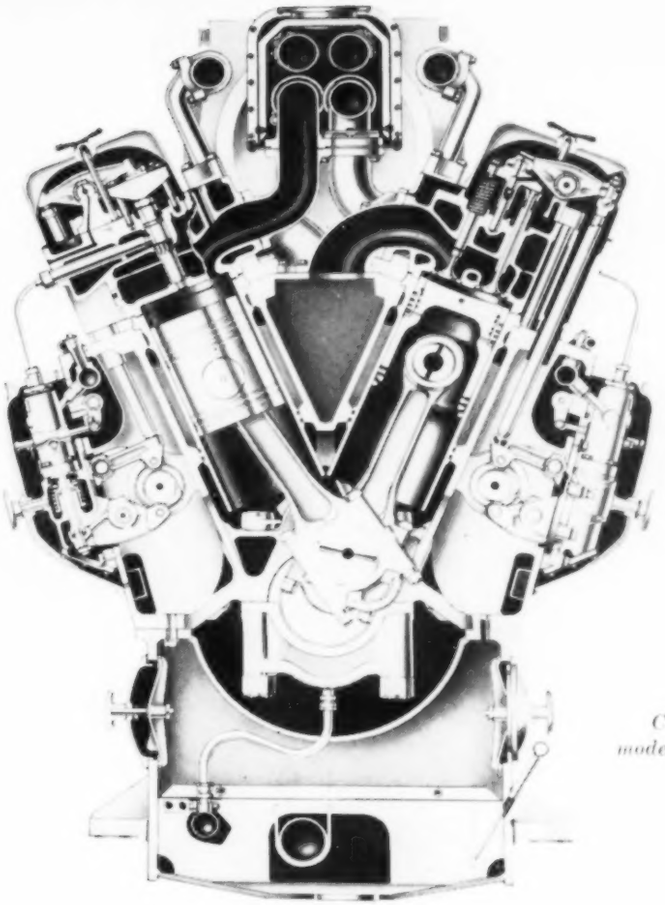
M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA, U. S. A.

TRY A CLASSIFIED AD IN PIPE LINE INDUSTRY

Idle Equipment – Idle Dollars!
Sell It Through a Classified Ad in Pipe Line Industry.

QUICK ECONOMICAL RESULTFUL

Need Engineers - Technical Personnel? A Classified Ad will get them for you.



Cross section of vee model ALCO *251 diesel.*

MODERN ALCO 251 DIESELS

ARE DESIGNED FOR LIGHTER WEIGHT, HIGHER POWER, LOWER COSTS

ALCO 251 diesel engines offer light weight, high power, utmost reliability — at low cost — for all stationary and marine applications. The basic 251 engine is easily adapted, by simply adding standard parts, to pipeline pumping, marine service, power generation, oil-well drilling, power "packages" and many other applications.

Available in three sizes, in-line six, vee 12 and vee 16, ALCO 251 diesels range in horsepower from 550 to 2400. All three models have interchangeable parts for easy replacement and maintenance. ALCO has located complete parts warehouses in seven cities throughout the country, and two "repair and rebuild" centers are also established.

You get better economy. Not only in low first cost from ALCO's production line, but in low operating, installation and maintenance cost the ALCO 251 diesel can mean a real economy.

ALCO 251 DIESEL ENGINE SPECIFICATIONS

No. Cyl.	Bore and Stroke (in)	RPM Range	BHP Range	Approx. Wt. Dry (lb)
6	9x10½	350-1000	550- 900	22,100
12	9x10½	350-1000	1100-1800	32,650
16	9x10½	350-1000	1470-2400	42,000

For further information about these modern, high-powered, light-weight diesels, contact your nearest ALCO sales office or write P. O. Box 1065, Schenectady 1, New York, for a new brochure giving all details.

ALCO

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In Pipeline Service...

MAKE SURE YOUR SMALL PIPING IS JOINED SAFELY, TOO

■ W-S Forged Steel Fittings provide safe, tight connections for your small diameter, high pressure piping. In gathering lines . . . pump and compressor piping . . . instrument lines and other high pressure lines, 4" and under in diameter, W-S fittings protect you against costly down-time. They're drop-forged for extra strength and toughness—and they're safety-factor designed.

Watson-Stillman Fittings are available in screw-end and socket-welding types in carbon steel, stainless steels and alloy steels. Send for your copies of our informative catalogs.

W-S FITTINGS DIVISION

HKP H. K. PORTER COMPANY, INC.

Roselle, New Jersey

Warren B. Weston to Direct Thew Shovel Overseas Company

Warren B. Weston, director of overseas operations for Thew Shovel Company, has been appointed managing director of Thew's recently formed overseas subsidiary, Lorain (Holland) N. V. Weston and his family recently took up residence in The Hague, where the company's operations are located.

Warren B. Weston

Weston joined Thew in 1937 as a design engineer. Later as division engineer, Weston developed the "TL" line of Lorain machines. He served for five years as manager of quality control for Thew, and when the company took over the operation of the Dixie Crane & Shovel Co., he became acting chief engineer for the new Lorain-Dixie machine. At the first of the year, Weston was appointed director of overseas operation.

Sparks Withington Buys Houston Pipe & Steel

The Flori Pipe Company of St. Louis and The Houston Pipe & Steel Company of Houston now constitute the pipe fabricating operation of the Sparks Withington Company, Jackson, Mich. Parent company of Flori Pipe since last February, Sparks Withington has effected the unification by purchase of all the stock of Houston Pipe & Steel.

This new combination will be under a unified administration with headquarters in St. Louis. Robert D. Flori, chief executive officer of Flori Pipe for the past six years, is president of the new organization.

All executives and key personnel of Houston Pipe & Steel are remaining, ex-

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, and JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF PIPE LINE INDUSTRY, published monthly at Houston, Texas, for October, 1956.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher Ray L. Dudley, 3771 Chevy Chase, Houston, Texas; Editorial Director, Warren L. Baker, 3324 Cherokee, Houston, Texas; Editor, Melvin A. Judah, 2211 Sackett, Houston, Texas; Managing Editor, Wallace Fitzgerald, 1514 Hewitt Drive, Houston, Texas; Business Manager and Executive Vice President, Tom W. Nelson, 2111 Locke Lane, Houston, Texas.

2. The owner is: The Gulf Publishing Company, Houston, Texas; James Anderson, Houston, Texas; Jane Wooden Dudley Bliss—Trustee, Houston, Texas; A. D. Burns, Houston, Texas; Grace C. Carter, Dallas, Texas; Margaret D. Cashman, Houston, Texas; P. Stilson Dudley, Eldorado, Texas; Ray L. Dudley, Houston, Texas; William G. Dudley, Houston, Texas; William C. Gross, Alpine, Texas; Carolyn Dodson Keeble, Abilene, Texas; Anita S. Lane, Houston, Texas; Charles H. Lane, Houston, Texas; L. J. Logan, Houston, Texas; James W. Nelson, Baytown, Texas; Tom W. Nelson, Houston, Texas; Walter Gaze Sterling—Trustee, Houston, Texas; O. R. Waller, Chicago, Illinois.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: NONE.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

RAY L. DUDLEY
Publisher

Sworn to and subscribed before me this 25th day of September, 1956.

P. J. AUCOIN
(Seal) Notary Public in and for Harris County, Texas
(My commission expires June 1, 1957)

pt J. A. Sims, former owner, who is re-ing to other interests. R. W. Reierson comes vice president and general man-er in charge of operations in the Hous-n area. All sales activity will be com-ned, former representatives of each mpany now representing the new organ-tion. Paul E. Kiebler is vice president charge of sales for the combined oper-on. Orders will be filled from St. Louis, ouston, or both plants as will best serve customer's needs.

National Cylinder Gas Names Two District Managers

National Cylinder Gas Company has appointed new district managers in Kansas City, Kansas, and Lubbock, Texas. Kenneth G. Dieker is the new Kansas City manager, and Robert L. Gabbard has taken over the Lubbock post.

Dieker was NCG manager in Lubbock for the past year and Gabbard served as manager of the firm's branch office in Fort Smith, Arkansas, since July, 1954.

Prodelin Appoints Koijane To Technical Liaison Post

Prodelin, Inc., of Kearny, N. J., announces the appointment of Donald Koijane as technical service engineer. Koijane will provide technical liaison between Prodelin's engineering staff with commercial and military users of Prodelin products.

Prior to joining Prodelin, Koijane was an Air Force electronic engineering officer on GCA Communications and Tropospheric Scatter System projects at the Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.

Howell Appointed Sales Engineer With Bethlehem Supply Company

Charles M. Howell has been appointed machinery sales engineer for Bethlehem Supply Company.

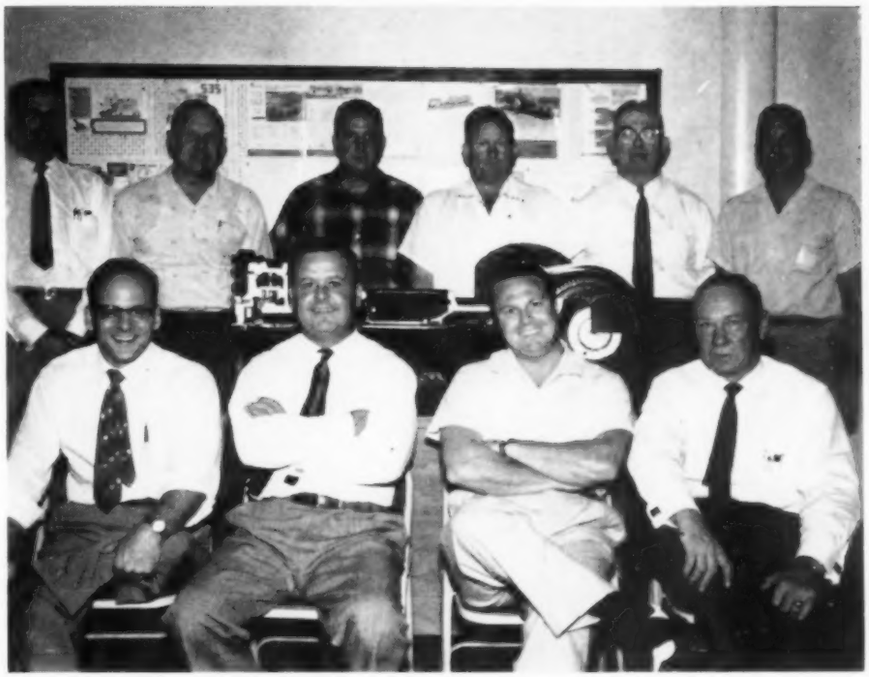
Howell previously was associated with Bethlehem in machinery sales, but left the company in 1948 to become the southern California representative for the Detroit Diesel Engine division of General Motors in petroleum industry sales. He was transferred to Tulsa as assistant manager of petroleum industry sales, a position he has held the past three years.

TRY A CLASSIFIED AD IN PIPE LINE INDUSTRY

Idle Equipment –
Idle Dollars!
Sell It Through a Classified
Ad in Pipe Line Industry.

QUICK ECONOMICAL RESULTFUL

Need Engineers – Technical Personnel? A Classified Ad will get them for you.



Frank Wheatley Representatives Meet

Midwestern and southwestern field representatives of the Frank Wheatley Pump and Valve Manufacturer met with the company's sales and manufacturing officials recently in Tulsa to discuss area sales policies. Attending were, left to right, back row, Huber Dye, Ray Hardy, George Blain, Orbie Sumner, R. V. Hackenjos, and John Barsalow. Front row, Bob Fisher, Gus Baker, Jr., Frank Wheatley, Jr., and Cliff Emberton.

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San Francisco opportunity for senior electrical or mechanical engineers with experience on oil pipeline and pumping stations or gas pipeline and compressor stations.

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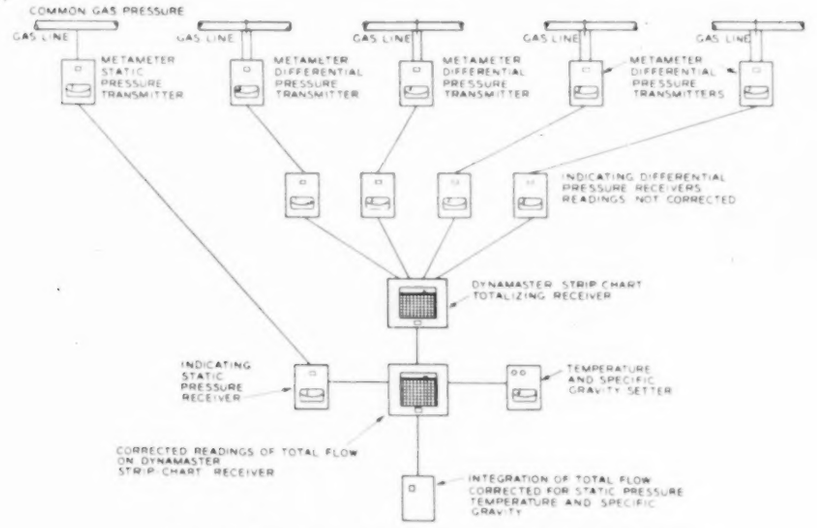
Paul Keating, Plaza 7-4400, New York City
Joe Braddick, Fairfax 3-2401, Houston, Texas
Bill Milligan, Tucker 1549, Los Angeles, Calif.
Don Palmer, Douglas 2-4032, San Francisco, Calif.

What's New in Equipment

for the Pipe Line Industry


COMMON GAS PRESSURE GAS LINE
GAS LINE
GAS LINE
GAS LINE
GAS LINE
METAMETER STATIC PRESSURE TRANSMITTER
METAMETER DIFFERENTIAL PRESSURE TRANSMITTER
METAMETER DIFFERENTIAL PRESSURE TRANSMITTER
METAMETER DIFFERENTIAL PRESSURE TRANSMITTERS
INDICATING DIFFERENTIAL PRESSURE RECEIVERS READINGS NOT CORRECTED
DYNAMASTER STRIP CHART TOTALIZING RECEIVER
INDICATING STATIC PRESSURE RECEIVER
TEMPERATURE AND SPECIFIC GRAVITY SETTER
CORRECTED READINGS OF TOTAL FLOW ON DYNAMASTER STRIP CHART RECEIVER
INTEGRATION OF TOTAL FLOW CORRECTED FOR STATIC PRESSURE TEMPERATURE AND SPECIFIC GRAVITY

Metameter Telemetering Equipment for Totalizing Flow of Gas through a number of pipes, corrected for Pressure, Temperature, and Specific Gravity.

Telemetering System

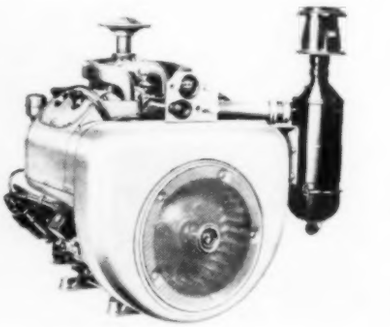
The Bristol Company has announced a new system of telemetering instruments which will totalize several flow measurements, correct for such factors as temperature, pressure, specific gravity and supercompressibility in fluids and which will provide a corrected flow value.

This system of telemetering transmitters and receivers and electronic self-balancing instruments can be used wherever corrected flow values are vital for proper operation.

These instruments can also be supplied in a variety of types to perform averaging, totalizing, multiplying, and dividing computations involving the basic measured variables listed above. In addition, systems which will extract square root values, obtain the square of the reading or compensate for a particular mathematical law can be supplied.

The computing systems are built up to fit a specific set of requirements from standard Bristol Metameter measuring transmitters. In a typical system, indicating or recording telemeter receivers retransmit the uncorrected flow values to a totalizing electronic instrument. At this stage, corrections for static pressure, temperature and specific gravity are made, either by signals from other Metameter transmitters or by manual settings, and the corrected total is recorded and integrated if desired.

For more data circle **No. E1** on Readers' Service Card, last page this issue.



Air Cooled Engine

Wisconsin Motor Corporation has announced a new model air-cooled engine. A 30 horsepower, 4-cylinder V-type engine, the Model VH4 is designed to fill the gap between the 25 hp model and the 36 hp model.

The new engine is of basic high torque design, traditional Wisconsin heavy duty construction and operates at a maximum speed of 2800 revolutions per minute. It can be adapted to operate on kerosene, natural gas, LP fuels or fuel oil of 38-42° Baume gravity and 35 octane rating.

Special equipment available for this engine includes hydraulic pump, visual-type air pre-cleaner, rotating screen, automatic high temperature switch, electric generator and starter, clutch assembly, reduction assembly or clutch-reduction assembly. The VH4 will be supplied as "open engine" with or without side-mount fuel tank or as a completely housed power unit with either built-in or underslung fuel tank.

(This item supplements Wisconsin Motor Corporation data on page 5309 of the Composite Catalog, 21st Edition.)

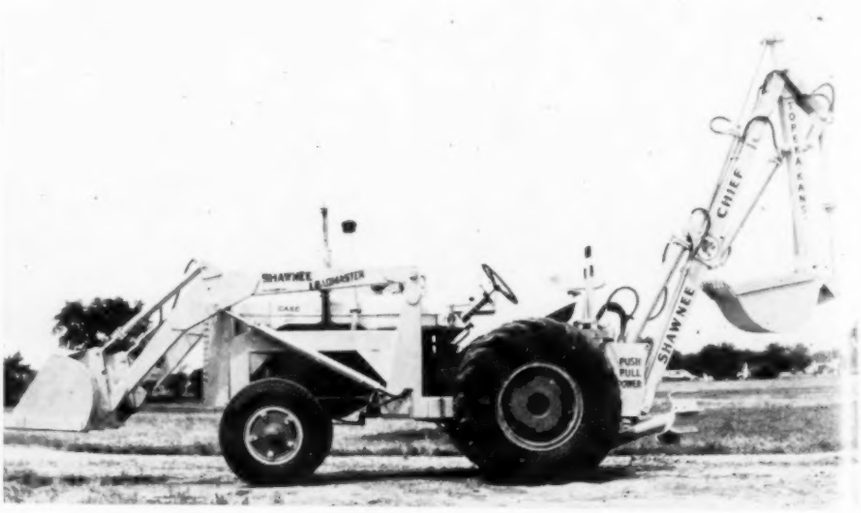
For more data circle **No. E2** on Readers' Service Card, last page this issue.

Backhoe

Shawnee Manufacturing Company, Inc., has placed on the market its new "Chief" backhoe, the D90. This backhoe digs effectively at the 14 foot level but its actual reach below the ground surface is 15 feet. This model has synchronized the action of a push cylinder at one end of the bucket boom axis with another pull cylinder midway between the axis and the bucket.

The Chief has three 120-degree quadrants of operating enabling the operator to switch the boom to either of the quadrants without moving from his seat. Hydraulically controlled feet stabilizers align the tractor for plumb digging such as when working sideways on a hill or with one wheel on a curbing. Only a few moments are required to position the tractor and backhoe for work. The control panel is composed of six spools, any of which may be used synchronously.

Heavy plate steel is welded to form the box frame construction of the main boom; main frame is constructed of one-half inch plate. Every moving part has replaceable bronze bushings, and the "Chief" can be moved from the tractor with only four pins in a few minutes.



For more data circle **No. E3** on Readers' Service Card, last page this issue.

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At W. H. Curtin & Company you will find complete stocks of the finest quality equipment for gauging petroleum — available for immediate delivery. Here are four popular items:

① Curtin Centrifuges, API, 15 cc and 100 cc.
② Curtin Hydrometer Carrying Case, 3-place.
③ Curtin Wood Case Tank Thermometers, API-ASTM.
④ International Centrifuges, API, 15 cc and 100 cc; for operation on 6-volt or 12-volt storage batteries.

Our technical staff will be glad to assist you in selecting the right equipment for your operation. Write for our "List of Gauging Equipment for Petroleum."

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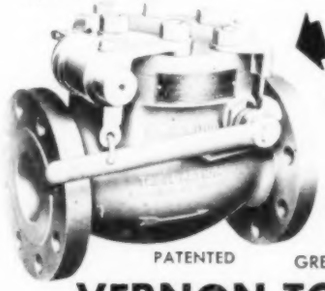
QUICK, POSITIVE ACTION

You want fast action when an emergency strikes. *Play it safe* and install GREENWOOD Triple-Action, Quick-Closing Valves on all lines handling volatile or combustible products. These valves shut off instantly in an emergency to protect your plant and equipment and to save human life.

Valve may be closed three ways: (1) Fire melts fusible link, (2) Applied air pressure or air failure, (3) Remote manual cable control. Can also be furnished with electrical solenoid operation. Get full details today, *before* an emergency strikes! Write for Bulletin GV-11.

GREENWOOD Triple-Action Quick-Closing Valves are available in 1", 2", 3", 4", 6" and 8" pipe sizes. Available for all types of services.



Play it Safe! with GREENWOOD

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PATENTED GREENWOOD VALVE DIVISION

VERNON TOOL CO., LTD.

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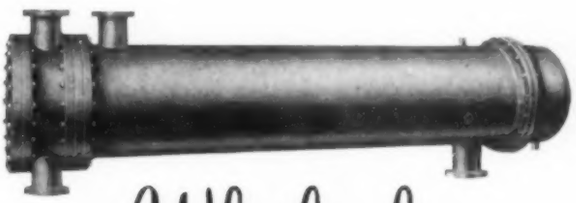
PROTECT YOUR COMPRESSORS FROM WASTE HEAT

The efficient operation of your compressors — in fact, their *life* — depends on the removal of waste heat from lubricating oil and water cooling systems. The Whitlock Type SG Cooler is specially designed for such service. It is small yet capable of handling relatively high heat loads, and its standardized design means low cost and prompt shipment.

The cooler is two-pass in design and properly baffled to develop high fluid velocities and subsequent high heat transfer rates, with minimum pressure drop. Its non-ferrous tube bundle, cast iron channel and steel pipe shell mean long, trouble-free equipment life even under severe operating conditions. Bulletin 122 gives you the whole story on Whitlock Lube Oil and Jacket Water Coolers. For your copy, just fill in and return the coupon today.



Whitlock

WHITLOCK Designs and builds: bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

THE WHITLOCK MANUFACTURING CO.
98 South Street, Hartford 10, Conn.

☐ Please send Bulletin 122 describing Whitlock Lube Oil and Jacket Water Cooler — Type SG.

Name _____

Title _____

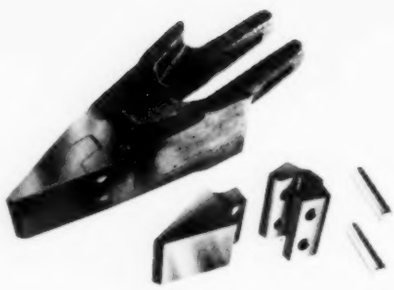
Company _____

Address _____

Digger Teeth

New design principles have been used in the Bulldog replaceable digger teeth for shovel dippers, back hoe buckets, dragline buckets, clamshell buckets and loader buckets just announced by Allied Steel & Tractor Products Inc. A Bulldog replaceable digger tooth has three parts—a universal weld-on adapter easily attached by using the old tooth as a base, a replaceable tip, and two positive lock pins for securing the tips to the adapter.

To attach the digger teeth, burn off the old tooth to the adapter size, weld on the adapter, and secure the replaceable tip to the adapter by tapping the pins in place with a hammer. Adapters are made in 15 widths to fit all popular makes of shovel dippers, back hoe buckets, dragline buckets, clamshell buckets and loader buckets.



For more data circle **No. E4** on Readers' Service Card, last page this issue.

NEW SINGLE SPEED . . . ALUMINUM HOUSING . . . POWER TAKE-OFF

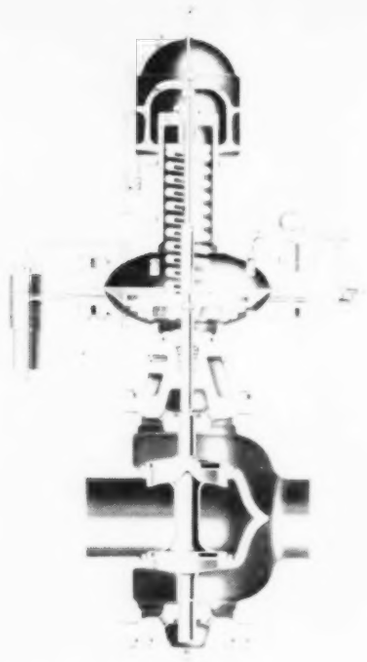
IT'S A TULSA® . . . ALWAYS BEST!

Important features that make this new TULSA power take-off outstanding:

- Die-cast aluminum housing . . . extremely lightweight
- Output shaft rotates on two needle bearings
- Three output shaft sizes
- Cable or lever control
- Low priced

This new power take-off for all medium duty work offers all the advantages of the complete TULSA line—highest quality, nationwide distribution and service.

Tulsa Winch
TULSA, OKLAHOMA DIVISION OF VICKERS Inc.



High Pressure Regulator

To solve the problem of vertical instability or "jumping" that is sometimes encountered on high pressure gas transmission lines, Fisher Governor Company has introduced a new high pressure regulator. Featured in the Series 883 and 885 regulators is an oil dash pot which will dampen out any tendency of the valve to jump, yet will not cause valve to deviate from control point.

Diaphragm casings are capable of withstanding 1000 pounds per square inch. Steel loading pilot is suitable for pressures up to 1000 psi and has an adjustable reduced pressure range of 100 to 450 psi. This new series is available in valve body sizes 2 inches through 12 inches.

(This item supplements Fisher Governor Company data on pages 1706-1707 of the Composite Catalog, 21st Edition.)

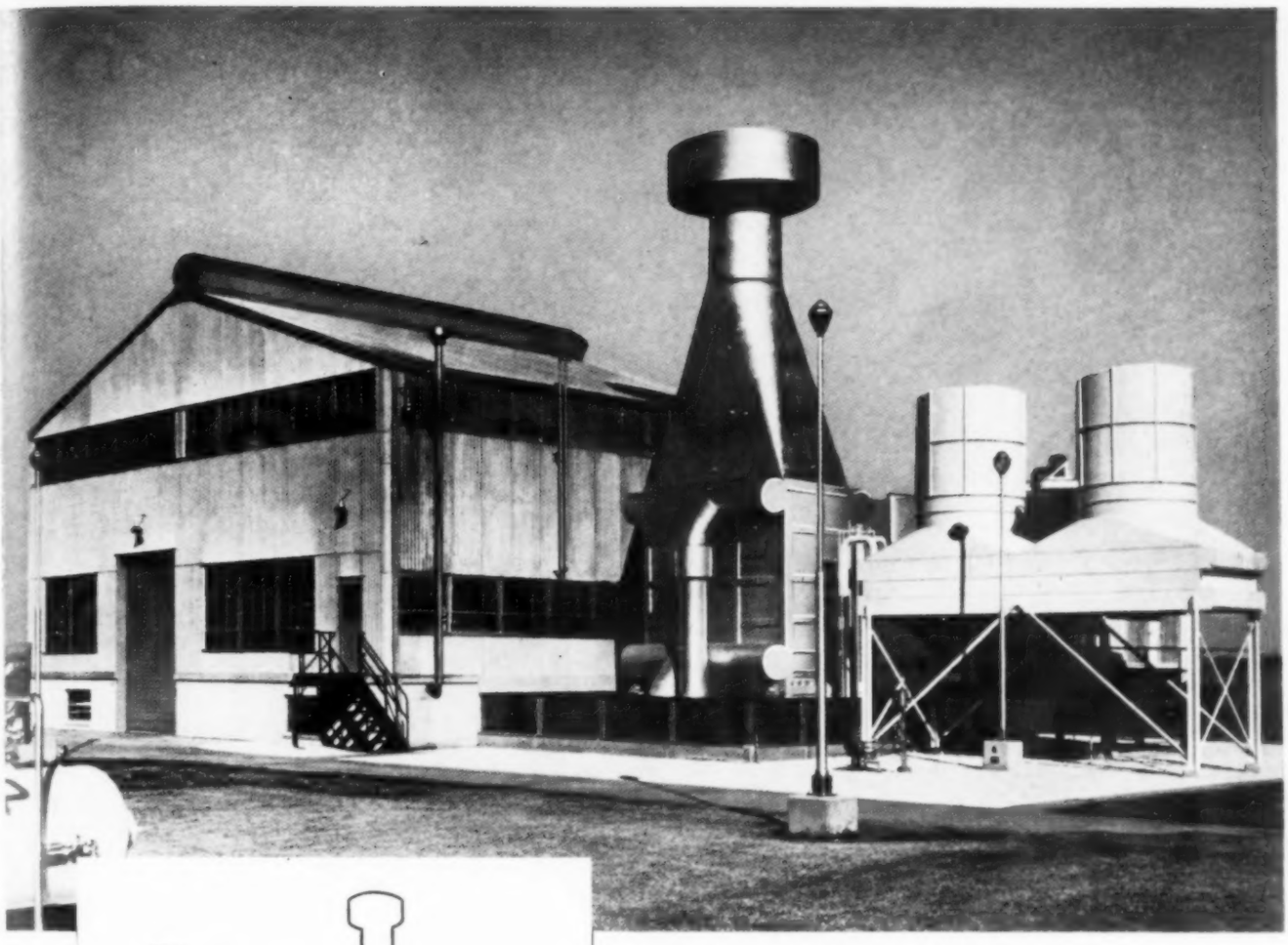
For more data circle **No. E5** on Readers' Service Card, last page this issue.

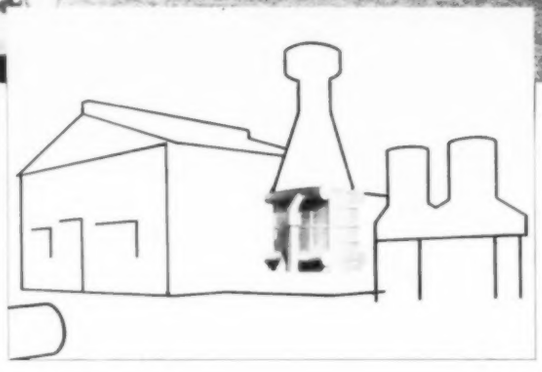
Potentiometers

High speed self-balancing recording potentiometers for use with analog-to-digital conversion devices have recently been announced by The Bristol Company. Designed to give full scale traverse in 0.1 seconds, the electronic Dynamaster can be equipped with most of the standard digital read-out devices presently available. Ample torque is available for operating retransmitting slidewires, alarm contacts and other auxiliary devices without affecting the dynamic characteristics.

Accuracy and reliability of the basic Dynamaster potentiometer and bridge instruments are unchanged when being used with the converters. Any measurement which can be converted to an electrical value can be read out in this way, including temperature, pressure, flow, differential pressure, pH, speed, power, smoke density, etc.

For more data circle **No. E6** on Readers' Service Card, last page this issue.





This is the Trunkline Gas Company's Edna Compressor Station with a Pin-Fin installed. Note the compactness of this regenerator.

* Specially designed "pin-like" shapes, which project inside the heat transfer core, give the new Air Preheater Pin-Fin its name. Their unique, patented design greatly extends heat-transfer surface area.

New Pin-Fin users are:

Tennessee Gas Transmission Co.	1 unit
Trunkline Gas Co.	3 units
Texas Eastern Transmission Corp.	6 units

NOW...economy in gas-turbine cycles with Air Preheater's new Pin-Fin* Regenerator

To compete commercially with Diesel engine steam-turbine and gas-engine cycles, a gas turbine must normally include a heat exchanger. And the most efficient unit for this service is Air Preheater's Pin-Fin—the new, extended-surface heat exchanger.

For example, a 75%-effectiveness Pin-Fin Regenerator in a gas-turbine cycle at 6-to-1 pressure ratio and a turbine inlet of 1500°F. will reduce fuel consumption by approximately 32%.

Air Preheater Pin-Fin Regenerators have been in service up to five years with no major maintenance problems. For details, call or write the Air Preheater Corporation.

MECHANICAL ADVANTAGES OF THE PIN-FIN

- **Compact**
- **Lightweight**
- **Quickly erected**
- **Minimum maintenance**
- **Convenient, one-unit design**
- **Readily disassembled**

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

Moto-Crane

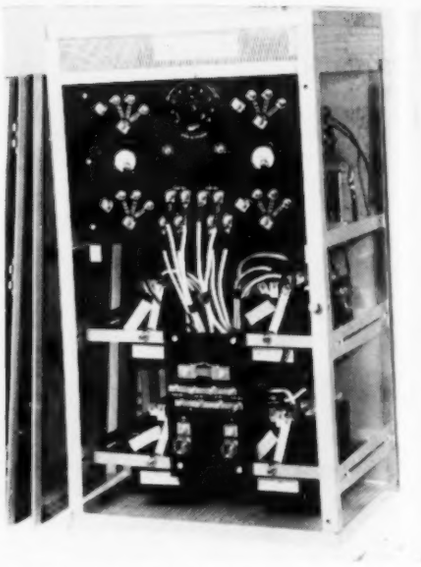
A 35-ton Moto-Crane has been added to the Lorain line of power shovels and cranes manufactured by Thew Shovel Company. The rubber-tire carrier for this model is of new design and is longer, heavier and stronger. Powered by either gasoline or diesel engines through either of the 10 or 15 speed transmission sets available, the Moto-Crane is 122-feet wide and can be supplied with 6 by 6, 6 by 4 or 8 by 4 axle arrangements. The 8 by 4 carrier permits greater lifting capacities without the use of outriggers and the double front axle gives better load distribution for improved flotation for off the road travel.

The new Lorain "shear ball" mounting is provided for mounting the turntable to the carrier. This mounting eliminates all adjustment and maintenance of center pins, center pin nuts and top or bottom rollers. It reduces lubrication need and seals out dirt and mud.

The new model uses the new Lorain square-tubular-chord crane boom made of alloy steel. It is lighter, stronger, has more capacity and can be used in greater lengths, up to 110 feet. Twenty-feet, 2 piece tip extensions of the same design are available, extendable to 30 and 40 feet lengths with center sections. Booms with extra wide bases are available for extra long boom service.

This new Moto-Crane is convertible to crane, clam, dragline or hoe.

For more data circle **No. E7** on Readers' Service Card, last page this issue.



Cathodic Protection Rectifier

The Electrical-Mechanical Division of the Good-All Electric Manufacturing Company has announced a new custom line of cathodic protection rectifiers.

The new unit is compact, air-cooled, light weight and easy to install. The case has a simple hinged door for access to meters and adjustable controls. Either or both sides are removable by simply removing two or three self-threaded bolts, thus giving access to any of the interior components.

For more data circle **No. E8** on Readers' Service Card, last page this issue.

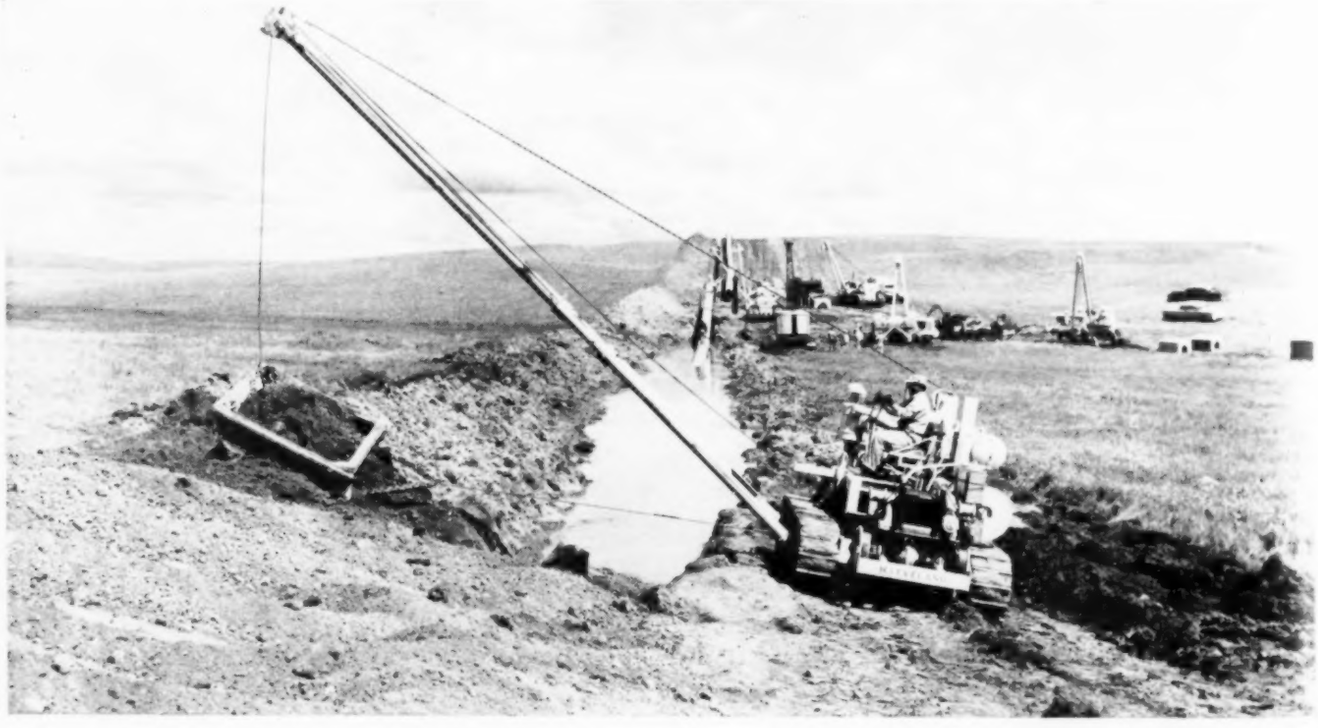


Photo courtesy Trans-Canada Pipe Lines, Ltd.

ON TRANS-CANADA PIPE LINES' 2,250-mile natural gas line, this fast working Cleveland 190 backfiller stays on the heels of the lowering-in gang. Boggy areas such as shown here near Swift Current, Saskatchewan, were frequently encountered. Perfectly balanced on wide, non-packing crawlers, the big 190 licks all types of terrain —swamps, hills, mountains—efficiently backfills heavy and light soils on both large and small diameter lines.

THE CLEVELAND TRENCHER COMPANY, 20100 St. Clair Avenue, Cleveland 17, Ohio

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HOLDS PARAFFIN IN SUSPENSION from FORMATION to REFINERY

Now is the time to give yourself a break with BrakeSol and clean the paraffin from your production system. Then keep it clean by setting up a program of constant treating.

FORMATION. Get more production by cleaning up the formation with BrakeSol. Use with frac jobs to get more effective results.

HEATER-TREATER. BrakeSol will allow the use of less heat, thereby increasing the gravity of your oil.

TANKS. Clean up that tank bottom by treating it back into the oil where it can be sold. Equally effective on the largest pipeline tank and the smallest stock tank.

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The ALSTON Pipe Cutter

is SAFER

saves TIME

and MONEY*

**Say hundreds of pipeline workers using the Alston Ratchet Pipe Cutter.*

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The Alston Pipe Cutter completely eliminates sparks . . . no line explosions. No more time consuming pipe bleeding.

quicker

This tool cuts 10-inch pipe in less than 15 minutes. Roller guides eliminate broken cutters. The ratchet makes working in close places easy.

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Begin to use this precision made cutter in your pipeline operation for safer, quicker, economical pipe cutting. Write for literature and prices.

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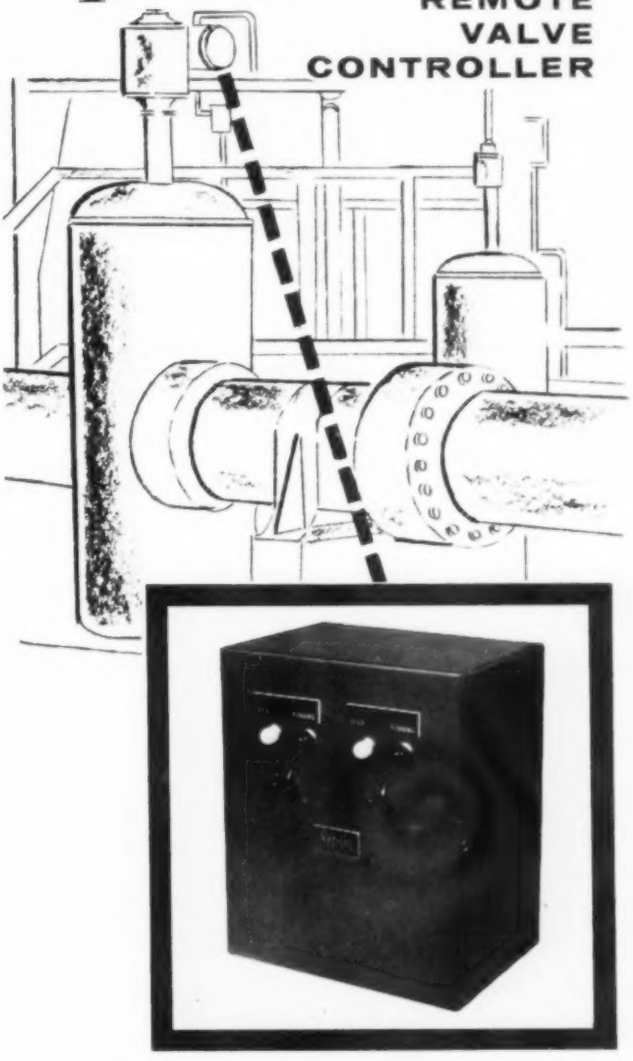
Sparton

REMOTE VALVE CONTROLLER



For Finger-tip Control Over Many Miles

Utilizes either a two conductor or single conductor and ground interconnection for long distance control. Employs DC impulses for remote open-close or proportional control of practically any valve.

Basic system provides valve status lamps on master control unit. Plug-in modules are easily added to provide additional supervisory lamps such as power failure; disagreement, control line failure.

Proven by use in many major pipe lines.

FULL STORY IN NEW BROCHURE

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The Sparks-Withington Company
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. . . you get

21% to 42% MORE ELBOW for the same cost

When You Use MIDWEST "LONG TANGENT" ELBOWS

90° LONG RADIUS LONG TANGENT
SIZES: 2" THRU 36"

90° SHORT RADIUS LONG TANGENT
SIZES: 14" THRU 36"

45° LONG RADIUS LONG TANGENT
SIZES: 2" THRU 30"

ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- ★ They save pipe.
- ★ They often eliminate short nipples and their extra welds.
- ★ They save time and money in lining up and clamping pipe and fitting.
- ★ They make it easier to apply slip-on flanges.
- ★ They remove the circumferential weld from point of maximum stress and can be sleeved.
- ★ THEY COST NO MORE THAN OTHER ELBOWS.

The long tangents available *only* on Midwest Welding Elbows give you *more fitting for the same price* . . . Midwest "Long Tangent" Elbows cost no more than other elbows. This added length has numerous advantages for the user of welded piping . . . advantages that save money and improve piping. For all the facts, ask the nearest Midwest distributor or write us for Catalog 54.

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MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader's Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card. Requests are transmitted to the manufacturer as soon as received by us for mailing of desired information directly to you.

Motor Pulleys

Worthington Corporation has published a new bulletin on variable speed motor pulleys. The bulletin describes motor pulleys, ⅛ through ¾ horsepower, available with adjustable and tilting motor bases, companion sheaves, motor bases and V-belts. The charts list complete ratings, dimensions and selection data for the various Worthington variable speed motor pulleys; the 24 QD sheave stock sizes; and Worthington-Goodyear V-belts.

To get a copy circle **No. E9** on Readers' Service Card, last page this issue.

Fittings

Manhole and handhole fittings for tanks and pressure vessels are described in a bulletin published by Colorado Fuel and Iron Corporation's Claymont Steel Products department. Available in a variety of sizes, shapes and specifications, these manhole frames and covers meet Underwriters Laboratory requirements for use on storage tanks containing hazardous liquids, either above or underground.

To get a copy circle **No. E10** on Readers' Service Card, last page this issue.

Pipeliner Machine

A new bulletin on the Insley pipeliner machine is available from Insley Manufacturing Corporation. The new folder illustrates pictorially new pipe line design features plus action photos of the machine at work. Working range diagrams, lifting capacity ratings and specification data are included.

To get a copy circle **No. E11** on Readers' Service Card, last page this issue.

Blasting Film

Atlas Powder Company has prepared a 2-minute color film for contractors faced with a public relations problem in the performance of blasting operations in and near populated areas. The motion picture describes precautions that blasters take to prevent accidents and protect private property. Modern methods of controlled blasting which reduce hazards of ground vibration, concussion and flying rock are emphasized. It is believed that showing the film to local groups will aid in reducing public ill-will which seems to arise primarily from a lack of lay understanding of blasting operations.

To get a copy circle **No. E12** on Readers' Service Card, last page this issue.

Cathodic Protection

A 32-page booklet on cathodic protection equipment for corrosion control is available from Standard Telephones and Cables Ltd. Illustrated with numerous photographs and drawings, the data include extensive technical information on installation, inspection and maintenance of the described equipment together with various schematic circuit diagrams. Also included is a listing of technical bulletins available on request.

To get a copy circle **No. E13** on Readers' Service Card, last page this issue.

Heat Exchangers

Alco Products Inc. has published a bulletin on its ALCOTWIN fin-tube heat exchangers. The bulletin describes the heat-transfer characteristics of the ALCO longitudinal fin tubes, which feature U-shaped fin channels integrally bonded to the tubes by heliarc welding. Included is a table of dimensions, a type designation table and finside coefficient and finside pressure-drop charts for all sizes of exchangers.

To get a copy circle **No. E14** on Readers' Service Card, last page this issue.

Hydraulic Fan Drives

The De Laval Steam Turbine Company has issued a new bulletin describing its hydraulic fan drive for air-cooled heat exchangers and cooling towers. The bulletin includes detailed information on the IMO motors and pumps and the worm gear reducers that make up the fan drive unit. Also included in the bulletin are performance curves useful for selecting the right unit for specific applications.

To get a copy circle **No. E15** on Readers' Service Card, last page this issue.

Selenium Rectifiers

An information sheet on the new air-cooled selenium rectifiers for cathodic protection against corrosion has been issued by Corrosion Services Incorporated. A few of the features of these rectifiers include simplified circuits, 50° —C ratings, easy adjustability and weather protection design. The bulletin shows drawings and gives specifications.

To get a copy circle **No. E16** on Readers' Service Card, last page this issue.

Circle numbers on Readers' Service Cards on last page

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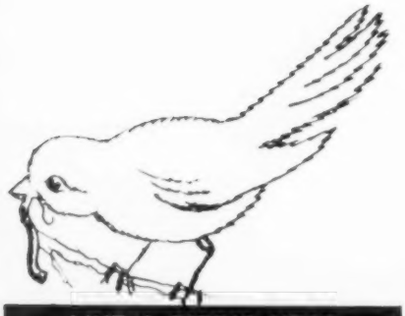

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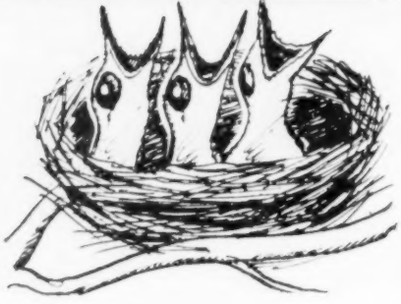

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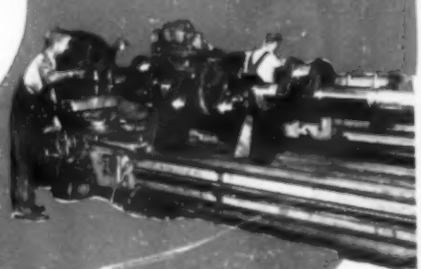

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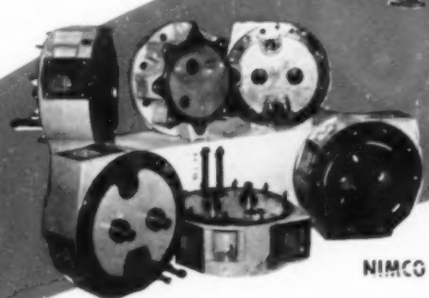

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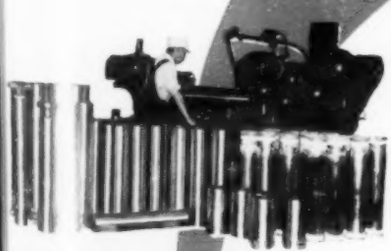

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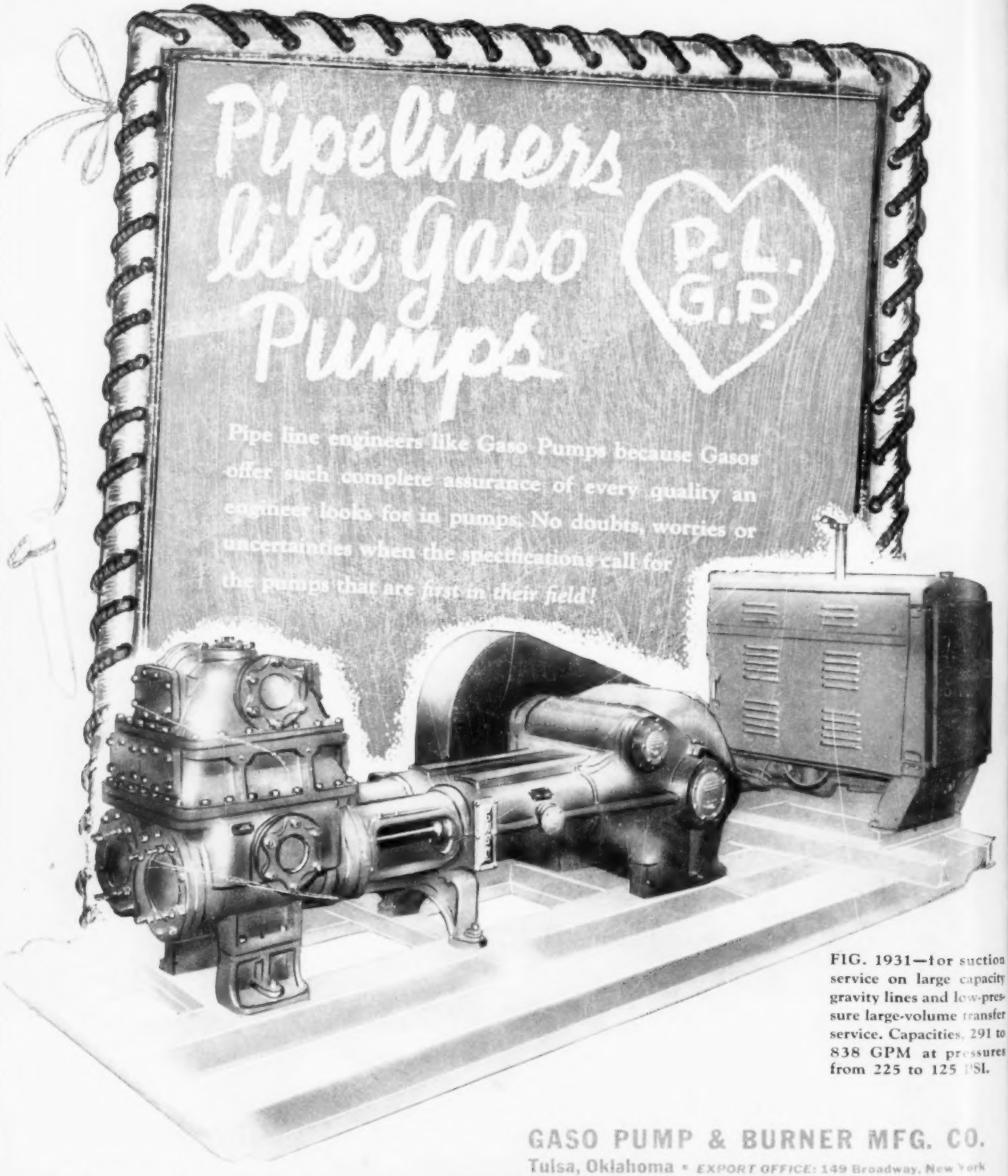
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